THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 50 Thursday, March 22, 1934 No. 918

PUBLISHED WEEKLY

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

Contents

	PAGE
Forthcoming Events	191
A Distinguished Career	191
Enamelling Cast Iron	191
Correspondence	192
Random Shots	192
Some Aspects of Non-Ferrous Founding	193
Effect of Mould Condition upon Cast Iron	195
The Qualcast Dinner	195
Refractories in American Cupola Practice	196
A Projected British Foundry School	197
The Electro-Plating of Castings	200
Woodworking Machinery Castings	202
Catalogue Received	202
Electrochemical Pickling Process	203
Dangerous Tin Position	203
Statistical Method in the Foundry	203
East Midland Foundrymen's Annual Dinner	204
Hardness Tests	204
Dorman, Long & Company, Limited	204
This Week's News in Brief	205
Trade Talk	205
Company Reports	205
Contracts Open	205
New Companies	205
Personal	205
Obituary	205
Raw Material Markets	306
Patent Specifications Accepted	306

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION

Institute of British Foundrymen

PRESIDENT: 1933-34

C. E. Williams, "Coniston," Cefn-Coed Road, Penylan, Cardiff.

LIST OF SECRETARIES—

General Secretary: T. Makemson, St. John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.
Birmingham, Coventry and West Midlands: L. W. Bolton, 21-23, St. Paul's Square, Birmingham.
Sheffield: T. R. Walker, 33, Ladysmith Avenue, Nether Edge, Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Lancashire: J. E. Cooke, 1, Derbyshire Crescent, Stretford, Manchester.
London: H. W. Lockwood, Stewarts and Lloyds, Limited, Winchester House, Old Broad Street, London, E.C.2.
Newcastle-upon-Tyne: J. W. Eckford, 4, Mosley Street, Newcastle-upon-Tyne.
East Midlands: H. Bunting, 82, Otter Street, Derby.
West Riding of Yorkshire: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.
Wales and Monmouth: J. J. McClelland, "Clydesdale," Dover Street, Bilston, Staffs.
Middlesbrough: F. A. Harper, Station Chambers, Middlesbrough.

National Ironfounding Employers' Federation

President: J. Smith, Smith & Company (South Shields), Limited, Nile Street, South Shields.
Secretary: Harold G. Judd, C.B.E., 8, Frederick's Place, E.C.2.

Foundry Trades' Equipment and Supplies Association

President: R. H. Brackenbury, 13, Victoria Street, London, S.W.1.
Secretary: K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association

President: W. E. Clement, Morfa Foundry, New Dock, Llanelly.
Secretary: E. J. Griffiths, 2, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION

The Registered Office and Laboratories of the B.C.I.R.A. at:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM
Telephone: Central 1885. *Telegrams: CIRA*

The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone* 332)

Forthcoming Events

MARCH 28

Institution of Welding Engineers (North-Western Branch):—Meeting at the Manchester College of Technology at 7.30 p.m. "Oxy-Acetylene Welding of Non-Ferrous Metal," Paper by A. G. Walker.

APRIL 12

Institute of Metals (London Local Section):—Annual general meeting in the Rooms of the Society of Motor Manufacturers and Traders, Limited, 83, Pall Mall, London, at 7.30 p.m. Open discussion.

Institute of British Foundrymen

MARCH 23

Middlesbrough Branch:—Meeting at the Cleveland Scientific and Technical Institute, Middlesbrough, at 7.45 p.m. "Some Notes on Special Steel Production—Historical—Manufacture—Properties—Defects," Paper by J. N. Kilby.

APRIL 4

London Branch:—Annual general meeting at Charing Cross Hotel, London, at 8 p.m. Short Paper competition.

APRIL 11

Lancashire Branch (Preston Section):—Annual general meeting at Technical College, Preston, at 7.30 p.m. "Moulding Machines and Fettling Plant," Paper by F. W. Neville.

APRIL 13

Middlesbrough Branch:—Annual general meeting at the Cleveland Scientific and Technical Institute, Middlesbrough, at 7.45 p.m. Further Report of Technical Section. Short Paper and general discussion.

APRIL 14

West Riding of Yorkshire Branch:—Meeting at the Technical College, Bradford, at 6.30 p.m. "Foundry Costs," Paper by F. Whitehouse.

A Distinguished Career

Metallurgists all over the world will have learned with profound regret of the death, on March 17, of Dr. W. Rosenhain. Born in Australia, he studied at the University of Melbourne, and came to England with an 1851 Research Scholarship. He entered St. John's College, Cambridge, and soon attracted the attention of the then Professor of Engineering, Sir Alfred Ewing, whose work had inspired an extraordinarily brilliant team of young men. In a Paper which has become classical, Ewing and Rosenhain described their studies relating to the deformation of metals, and announced the discovery of slip bands, which have since become a commonplace of the metallurgical text-books. After leaving Cambridge he entered industrial work for about five years, and pursued in his spare time the examination of metallic structures by what was then a comparatively new method of approach, the microscope. Sir Richard Glazebrook, then Director of the National Physical Laboratory, invited him to take charge of the then very small and recently-established department of metallurgy at the Laboratory, and for nearly a quarter of a century Dr. Rosenhain worked to build up what has become the largest and best-known metallurgical research laboratory in the world. The stream of Papers on both ferrous and non-ferrous subjects made his name internationally known. Honours early came his way. He was elected a Fellow of the Royal Society at an unusually early age, and from the beginning was a supporter of the Institute of Metals, of which he became President and Fellow. His review last year of twenty-five years' metallurgical progress to that body showed no loss whatever of his range of knowledge and superb exposition. His facility in speaking and logical thought made him a welcome speaker at discussions and ceremonial occasions. He was a member of Council of the British Cast Iron and Non-Ferrous Research Associations and a Bessemer Medallist of the Iron and Steel Institute. He was, at the time of his death, President of the International Association for Testing Materials, the next congress of which in London in 1935 he had been actively arranging. As recently as March 13 the University of Birmingham honoured him and itself by presenting him with the Turner Gold Medal. Scientific metallurgy can ill spare a man of his attainments in what seemed to many the prime of life, and this sketch of his career may serve to stimulate further the work of those younger men who will carry on the work he has laid down.

Enamelling Cast Iron

The creation of an Institute of Enamellers is a matter of profound interest for foundry executives, as enamelling is an industry which is so closely associated with the light-castings industry. The interests to be covered are those of the vitreous or porcelain enamellers to the exclusion of stove or synthetic enamellers. Some of the latter, apparently, would like the buying public to be hazy as to difference in the finish given by the two processes, whilst others of the more enlightened type consider that the two processes are complementary and not antagonistic. For instance, no honest stove-enamel manufacturer would recommend his wares for baths or the inside of cookers, but has justification in pressing for the adoption of his wares for the feet of baths, in oven doors, if adequately heat-insulated, for gas and electric fires, and for a hundred-and-one other jobs, where hard wear and low-heat conditions obtain.

The proposed new Institute will do more in a year to delineate and rationalise the two processes than all the salesmen's talk will accomplish in twelve. It should result in figures being made available of deterioration of surfaces under specific conditions, correlated with costs. Stands at the British Industries Fair showed very clearly that the foundry industry was using both processes to an increasing extent. Each has its own legitimate field, incorporating a disputed territory, which science and time will allocate to either the one or the other.

Both processes are utilitarian and also of sales-promotion value. At the moment their use is confined by founders to the light-castings section, but stove-enamelled finishes are well worth consideration by the agricultural- and dairy-implement manufacturers, as finish is of vital importance as a sales factor. Brilliant glossy finishes, of all colours, dappled, marbled or grained can be obtained by three sprayed coats, plus a drying process lasting from half-an-hour to an hour, depending in mass at 130 deg. C. Machines so treated would command the attention of buyers in those parts of the world where the buyers are definitely impressed by colour.

C

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Cupola Practice

To the Editor of The Foundry Trade Journal.

Sir,—In Mr. Weeks' informative Paper, "Modern Iron Foundry Practice," published in your issue of March 8, there is a section dealing with "Balanced-Blast Principles."

With this, as with some other accounts of this interesting cupola, I find myself not altogether in agreement, and in the hope of stimulating further discussion, offer the following notes as reasons to account for the coke economies and freedom from oxidation obtained.

1.—There is a lapse of time before the O_2 of the air entering through the tuyeres is converted wholly either to CO, or CO_2, or both. Taking

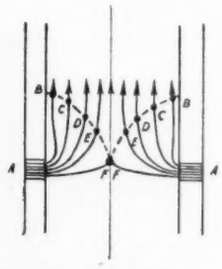


Fig. 1.—Section above Tuyeres.

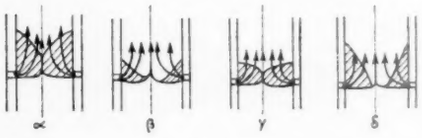
the coke bed as being at an approximately uniform temperature and uniformly packed, this period will be the same, no matter what the path of the gases. Diagram 1 shows paths AB, AC, etc., of equal length, and we may therefore expect to find an oxygen-free zone, above the surface defined by BCDEF, etc. This is what Belden found experimentally. This cone may be steeper than indicated, as there is probably a tendency for more air to flow up the walls than elsewhere, due to less resistance to flow.

2.—The average depth (per unit cross-sectional area) and shape of the oxidising part of the bed may be varied by changing

(*a*) the volume of air flowing and

(*b*) the size of the tuyeres, altering (*a*) and (*b*) either singly or together. The effects of such changes would be probably as follow:—

(α) By increasing tuyere area and volume flowing, so maintaining inflow velocity constant, the



Tuyeres			
Increased	Decreased	Decreased	Increased
Volume			
Increased	Decreased	Normal	Normal
Velocity			
Normal	Normal	Increased	Decreased

Fig. 2.—Possible Variations.

top surface of the oxygen-free zone would be raised and the oxidising part of the bed increased in average depth.

(β) By decreasing tuyere area and volume flowing, so maintaining inflow velocity constant, the top surface of the oxygen-free zone would be lowered and the oxidising part of the bed decreased in average depth.

(γ) By decreasing tuyere area, but retaining original volume, so increasing inflow velocity, the conical surface would tend to flatten. I prefer not to guess the effect on average depth for cases (γ) and (δ).

(δ) By increasing tuyere area, but retaining original volume, so decreasing inflow velocity, the conical surface would be more steeply angled.

I suggest that in the balanced blast cupola (β) is the course followed, with consequent decreased oxidation.

3.—Additional air enters the cupola above this zone, usually through three rows of small auxiliary tuyeres. The free oxygen zone for each such tuyere is localised, and not likely to cause appreciable oxidation.

4.—The net effect of 2 (β) and (3) is that there is a hot coke bed considerably deeper than on most cupolas. Because of this increased depth, a drop of molten iron in its path to the well is in contact with hot gases, or coke, for a longer time than usual. Therefore—

(*a*) To obtain molten iron of normal temperature, the bed need not be so hot as is usual in the ordinary cupola, or

(*b*) If the bed is as hot as usual, the iron will be hotter than is normal.

5.—There seems to be no reason to expect the chemistry of the gas reactions to be appreciably different as between this and any other cupola. Space and time factors may, however, enter in.

The balanced blast cupola lining increases in inside diameter above the melting zone. This has the effect of—

(*a*) Reducing the gas velocity through the charges, and therefore giving any single gas particle a longer time in which to give up its sensible heat, and also for the CO to deposit carbon according to the reaction.

$$2CO \rightarrow CO_2 + C.$$

(*b*) Because of the economy obtained from (*a*) and, of course, 2(β) and (3), a given cupola will contain a greater weight of metal per unit weight of hot gases than normal, with further sensible-heat economy.

6.—So far as I know, figures have not been published showing the ratio $\frac{\text{weight of air blown}}{\text{weight of coke burnt}}$ for the balanced-blast cupola. Such figures, together with similar figures for an ordinary cupola—both cupolas being worked so that there is no free O_2 at the top of the charges—would suffice to show to what extent the improved efficiency is due to chemical factors, *i.e.*, a larger $\frac{CO_2}{CO}$ ratio in the outgoing gases, and how much to physical factors, such as depth of hot bed.—Yours, etc.,

F. W. Neville, Engineer.
(For J. W. Jackman & Company, Limited.)

Vulcan Works,
Blackfriars Road, Manchester.

P.S.—In regard to (3) above, I do not agree with Prof. Thompson and others, that the use of upper tuyeres "is merely to reproduce more or less the conditions which obtain at the lower tuyere zone."

The reaction $CO_2 + C \rightarrow 2CO$ will surely be slower as the proportion of CO is increased in the reacting gases; and this proportion is clearly much greater at the upper than at the lower tuyeres. Further, the time interval before the gases reach a zone where the reaction is reversed is also less for the upper than for the lower tuyere gases.

The relation between upper and lower tuyere areas is, of course, important.

Welding Cast Iron

A new electrode, "Ferroweld," has been produced for welding cast iron. The new electrode has a steel core surrounded by a heavy flux coating which protects the arc from gases injurious to the weld which are present in the atmosphere. The electrode is manufactured in only one size—$\frac{1}{8}$ in.—and is used with approximately 80 amps. of current.

Random Shots

We are accustomed to have people patting us on the back. Congratulations are everyday stuff to us. When the Editor reads a particularly ecstatic pæan of praise from someone who likes "Random Shots," he merely tugs at his tie, smooths his hair, and murmurs, "'The best literature since Shakespeare?' Oh, well, hardly that, perhaps." Even so, he feels that the following letter from an admirer hardly strikes the right note. He wonders whether somebody is pulling his leg.

* * *

Dear Sir,—I much regret to see the severe criticisms made of commercial correspondents by "Marksman" in your issue of the 8th inst. May I inform you, Sir, that I have pinned my faith to them throughout my business career; furthermore that I have religiously based my buying policy upon the weekly pronouncements in The Foundry Trade Journal ever since the first issue came out in 1902?

Your first issue said "The outlook is good. Consumers would be well advised to buy stocks of commodities." I bought. At the time, I was in charge of a small foundry in the Midlands; we had little capital, but, with complete assurance, I contributed my personal fortune. I bought 10,000 tons of Cleveland G.M.B. at £2 10s. per ton. Prices fell at once, but you said, "Better times are coming," and I held on. *You were right.* Pig-iron recovered to £3 per ton, and I had made a nominal profit of £5,000. Indications still pointed upward, however, so I steadily refused to sell.

About this time the foundry went bankrupt, and the liquidator refused to take over the pig-iron. He said it was mine, but offered to rent me standing-space for it. I refused and had it moved into my back-garden. My financial position was very shaky, but I was supported by the weekly encouragement in the F.T.J.

Faith was justified when in 1914 the war broke out. Stocks were commandeered at high prices, but I managed to camouflage mine as a rock-garden. The time to sell had not yet come. 1915 came—1916—and I still held on. Prices rose and rose. By now I reckoned myself a semi-millionaire. F.T.J. commercial correspondent said "The market outlook is very bright," however, so I forbore from selling.

1920 saw a boom (£11 per ton)—then came a slump. Things were beginning to get beyond me, but I held on doggedly. Then came 1931 and the Depression. Did I sell? No! By hook or crook I managed to hold on. I got through somehow, but the strain was too much for me. I decided to sell out last week, and sent for a buyer. I was tired.

He said the iron was tired too, but bought it as ballast. Interest included, I must have lost about £25,000 since I bought the dam stuff. I am convinced, however, that had I been able to carry on under your correspondent's advice, I should eventually have made money,—Yours,

"Hopeful."

* * *

Personally, "Marksman" feels that "Hopeful" is altogether too hopeful.

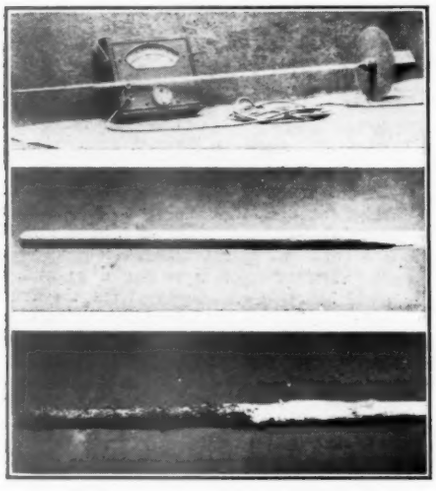
Marksman.

Some Aspects of Non-Ferrous Founding

By Arthur Logan

Introduction

In these days when reams of technical literature flood the country, and scores of lectures are given before technical societies each session, it becomes increasingly difficult to say or write anything original or novel upon such a general subject as "non-ferrous foundry work." Yet, when one comes to consider the matter, it will be realised that the problems of the present are just exactly the problems of the past, although perhaps intensified. Intensified, that is, by the more rapid rate of life in general; by the higher output expected; by the more stringent economic conditions, and by the greater physical demands of modern engineering. If ever there was a time when science (using the term in its broadest sense) has got to pull its weight, it is the present. Every advantage must be taken of the most economical methods of production. Unnecessary handling of materials must be eliminated. Wasters must be cut down to the lowest possible,



Figs. 1 to 3.—Fig. 1 (Top) Complete Pyrometer and Indicator; Fig. 2 (Middle) Sheath prepared for Immersion, and Fig. 3 (Bottom) Sheath after 160 Immersions.

and so one could go on. It means, in short, that every foundry operation must be carefully scrutinised, studied and overhauled.

Special Conditions

The question of sound buying of raw materials is one which is vital in non-ferrous foundry work, for a brass foundry can sink or swim entirely on the result of its buying of metals alone, apart from any question of technical efficiency or inefficiency; but as such buying is seldom entirely in the hands of the practical foundryman, it is not proposed to deal with this particular point. The question of the most economical method of production is a big subject, and it is impossible to deal with it satisfactorily on general lines. It is essentially a thing which must be studied in the individual foundry, with a full knowledge of the type of work to be produced. It is seldom in non-ferrous work that one finds sufficient off any one pattern to justify the type of mechanised foundry which is becoming more general in the ferrous world. At the same time, a greater selection and variety of moulding machines and appliances appears on the market each year, and amongst the number available, it should not be very difficult to find a type which will be a paying proposition for small numbers off, or even for sheer jobbing work.

Core-Blowing Machines

Within the last year or so, a new type of machine has appeared—the core-blowing machine—for the rapid production of cores which are blown by means of compressed air. This machine is revolutionary in repetition foundries, and is gradually being applied to jobbing work also. It has great possibilities. With the question of machine adoption is also bound up the question of unnecessary handling of materials. With rapid methods of production, the question of sand control comes to the fore. Personally, the author is strongly of the opinion that the future will see the universal adoption of a unified system of sand control. This is a natural development, whether a foundry is on repetition work or not. In the foundry of the future, the whole of the moulds will be knocked out over a knock-out grating, whence the sand will be conveyed to a central cleaning and preparation plant, there to be cleaned, renewed, and made up to a definite standard, and then issued for use as required. The physical properties of the issued sand will be known and under control; and there will then be one less variable for the foundryman to contend with.

Waster Elimination

"Wasters must be eliminated" is a statement which it is easier to make than to remedy, for, after all, are not nine-tenths of the foundryman's working hours occupied by this particular problem? The problems of the present were also the problems of the past. Nowhere more than in foundrywork is it realised that knowledge is not accumulative. If each generation could start where the last left off, then foundry problems would probably all have been solved by now; but, unfortunately, it is not so. The same mistakes constantly recur. The problems which one foundry met and overcame in the past will be met and tussled with by another, and will probably even recur later in the same foundry.

Foundrymen, and the casting of metals, is, after all, the practical application of certain definite physical and chemical principles—and it all depends upon how closely the practical operations follow the theoretically-correct principles, as to how good or bad the finished result will be. It follows from this, therefore, that it should be the aim of the foundryman to acquire some knowledge of the first principles involved, and then, when trouble arises, he is in a sound position to tackle it logically. This all seems a little platitudinous; but having for twenty years viewed foundry problems from the calm detachment of the laboratory; and now, being actively concerned and directly responsible for foundry production, the truth of this statement is brought home to the author more and more every day.

Casting Temperature

The author has on many occasions advocated control of casting temperature and outlined the reasons and stated the benefits to be obtained. It is only within the last year, however, that a policy of complete control has been put into operation which involves the recording of the complete temperature and history of every crucible of metal melted. This necessitates, in the first place, consecutively numbering each casting with a cast-on serial number, where there is more than one off the pattern. Complete records are then kept which show the make-up of the charge, the time in the fire from charging to pouring, the temperature of pouring and exactly what castings are poured, with the sequence in which they are poured if more than one mould is cast from one crucible.

This is necessary in order to arrive at an approximate pouring temperature for the subsequent casting or castings. It will be obvious that a crucible, when once lifted from the furnace, commences to cool fairly rapidly. If the typical cooling curves for the various-sized crucibles in use are known, the approximate temperature at any time after the original temperature has been taken can be fairly accurately obtained. The converse holds also, although not to such a great degree, perhaps, as the state of the furnace will obviously affect the rise; but by taking a temperature bearing as the crucible is being superheated, to its pouring temperature, it is possible to predict the time when the crucible will have reached the required temperature and be ready to be withdrawn for casting. The method actually adopted is to take an initial temperature usually when within about 50 deg. C. of the required temperature, then the time the crucible will reach the required temperature can be estimated to within a minute or so. A check temperature is then taken at the estimated time, and this is rarely found to be far out. The advantage of this system is that there is

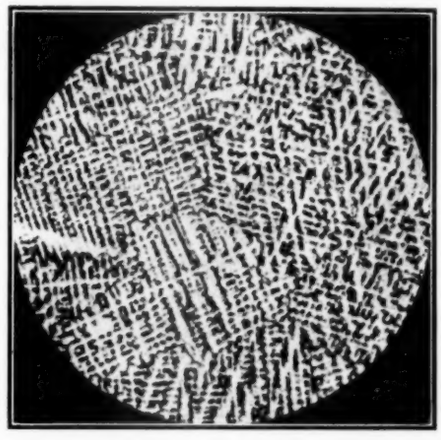


Fig. 4.—Structure of Sound Material.

no possibility of overheating or "stewing" of the charge. Furthermore, the exact time the metal will be ready is known in advance, and arrangements to deal with it can also be made in advance. This means that the crane is on the spot waiting to draw the crucible at the right moment, and the previously-warned moulder is ready to skim and cast as soon as the pot is withdrawn.

Sound Castings

The question of sound castings is very much bound up with melting practice and temperature control, and inattention to this point will inevitably mean a heavy bill for "wasters" if the melting is uncontrolled or left to the judgment of even the most perfect of melters or furnacemen. The fact is not sufficiently realised, and it is impossible to over-emphasise the point, that there is no such thing as being able to judge the correct casting temperature of even any one alloy from day to day; much less can it be done where a number of different compositions are in use. Human judgment cannot be relied upon to give the same temperature day after day. It would seem unnecessary, and in fact almost childish, to reiterate this elementary statement, which has been made scores of times, yet how many foundries completely or systematically exercise temperature control? Dozens of instances could be given where the furnaceman has been asked to indicate when, in his judgment, the metal had reached the correct casting temperature. In the case of one alloy alone, Admiralty

*A Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. A. Phillips presiding.

gunmetal, during a period of nine months, the outside limits found in this way when checked by pyrometer were 1,080 to 1,300 deg. C.—giving the almost incredible range of 220 deg. C.; and this by an experienced man definitely aiming at a certain temperature, with one alloy.

The correct casting temperature of phosphor-bronze is notoriously difficult to judge by eye, and the usual "rule-of-thumb" method is to draw the crucible at an obviously too high temperature, and allow to stand and cool whilst various "knowing" moulders observe and commune together, the while one of their number

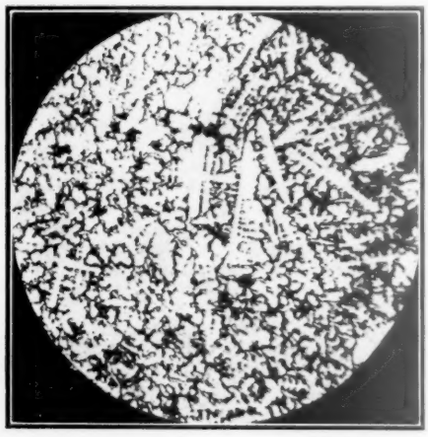


FIG. 5.—STRUCTURE OF UNSOUND MATERIAL.

gently and gracefully draws a skimmer across the top surface. One hesitates to think what the percentage of wasters can be under these conditions.

If the matter is carefully considered, it will be appreciated that the only logical thing to do is to control the temperature by pyrometer entirely, and give the operator in charge of the instrument the full authority and complete control of the casting temperature of every mould poured. In the small foundry, this would naturally be carried out by the foreman; but in large foundries, the amount of work involved necessitates the services of a special man. His duties would include the fixing in advance of the casting temperature for every mould made, the responsibility for seeing that the crucible was drawn immediately the temperature was reached, which would give the correct casting temperature, and the recording of the complete particulars of every mould poured.

Economy Realised

It might be argued that the retention of an operator to control casting temperatures which were previously judged by the furnaceman or moulder is uneconomical and unnecessary expense. On the contrary, it has been found to be excellent economy—the reduction of wasters and better castings generally far outweighing the cost of the service. It will further be appreciated that it is desirable to remove the whole question of temperature into the hands of a person who has no axe to grind other than the production of the most nearly perfect casting. The furnaceman may be rushed—therefore, the urge is to get the crucible out before its correct casting temperature is reached. This frequently happens, and personal experience has shown that errors on the low side are more common, and just as harmful, as errors on the high side. At the same time, errors on the high side do occur. The furnaceman may be occupied with some job which distracts his attention or the moulder may not have the mould ready. Under this system of control, these difficulties are eliminated.

One of the greatest difficulties in the past which discouraged any attempt at systematic temperature control, was the very practical difficulty of getting a pyrometer which would be sensitive enough to give a reasonably rapid reading, and yet substantial enough to withstand the frequent immersions. A practical pyrometer has been evolved by the laboratory which meets the conditions very well, and details of its construction are given in case they may be of interest to others.

Type of Pyrometer Recommended

Fig. 1 shows the complete pyrometer and indicator. The length of the tube portion is 4 ft. 6 in., and this is necessary to reach to the metal level in the furnace without discomfort to the person using it, and also to keep the cold junction at a low temperature. The tube consists of fused silica and is $\frac{1}{2}$ in. dia. with $2\frac{1}{2}$-mm. thick walls. It is closed at one end. The thermocouple itself consists of two wires of 0.016 in. dia., one of pure platinum and the other of platinum-rhodium. These wires which originally are 6 ft. long, are fused together at one end and the free ends are coiled on drums in the cold junction box. One wire is encased in a thin fused silica capilliary tube, inside the main tube. From the junction box, the leads go away to the indicator, which is of the dead-beat type.

If one takes a bare silica tube such as described, and immerses it a time or two in a pot of liquid bronze, it will not be long before the end disappears, as the attack is fairly rapid. Under these conditions, perhaps six or eight immersions might be obtained before the sheath finally gave up the ghost and presented one with a crucible of bronze containing small amounts of the rare elements, platinum and rhodium. As the platinum wires cost 1s. 6d. an inch, and the silica sheaths cost 13s. each, this is not to be recommended. Actually, the life of a sheath in the foundry averages approximately 160 odd immersions, and the way this is obtained is to give it a $\frac{3}{32}$-in. coating of plumbago and china clay (Fig. 2). After every four or five immersions the remnant of coating is scraped off, and another coating applied. The object is to prevent molten metal ever coming into contact with the sheath.

A year's experience has shown this arrangement to be perfectly practical—the sheaths averaging, as stated, over 160 immersions (Fig. 3). At intervals, it is necessary to anneal the platinum wires, and when the two or three inches at the hot junction begin to discolour with constant use, they are clipped off, and a new junction fused together. The amount that was cut off is now fed forward from the spare on the drums in the cold junction box. It is just as well, of course, to have a complete spare couple and sheath ready to connect up at a

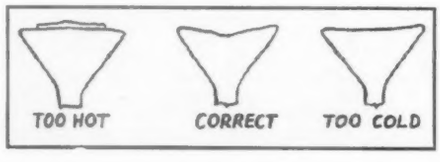


FIG. 6.—TYPES OF RUNNER HEADS ASSOCIATED WITH CASTING TEMPERATURE.

moment's notice. The actual running costs for sheaths works out at approximately 1d. per immersion.

Casting Temperature

With regard to actual casting temperature, this has been dealt with by many others, as well as by the author, on numerous occasions, so that it is not proposed to add much more on this point. Obviously, there is a range of casting temperature for every alloy, and within this range there will be a correct casting temperature for any individual casting which will give the maximum degree of soundness. In this connection, it should be remembered that there is no such thing as a perfectly sound casting. Perfectly sound, in this case, being taken to mean a casting in which every cubic inch is the maximum density of which the alloy is capable. This is regulated largely by uniformity or otherwise of section, mass, casting temperature, rate of cooling, freedom from dissolved gases, oxides, etc. Of these, casting temperature is the only factor which is under immediate direct control, and it follows that the casting will approach the maximum best possible, just in so far as it approximates to the correct casting temperature—whatever that may be for the particular alloy and object being cast. The terms "just right,"

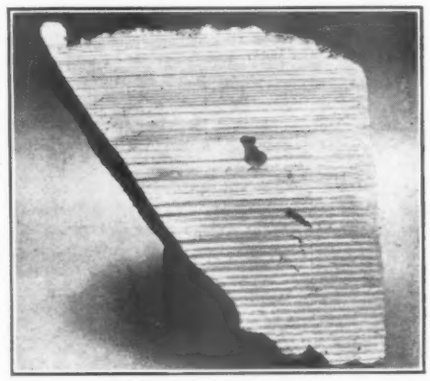


FIG. 7.—SECTION OF RUNNER HEAD SHOWING DEFECT.

"hot," or "dull," which are common foundry parlance, are absolutely valueless. What may be regarded as "hot" by one man may be "just right" to another, and both may give opposite versions later the same day; and, in any case, be 50 deg. or more from the truth. The only sensible action, therefore, is to eliminate the human element altogether; find out by experience what the normal casting range for a particular alloy really is, then put the whole onus of pre-judging the required casting temperature of every casting on to one man, whose responsibility it will then be to see that the casting *is* cast at the required temperature.

An alloy such as Admiralty gunmetal requires to be superheated about 200 deg. C.—that is to say, the normal casting temperature is round about 1,180 deg. C. There is a normal casting range of 30 deg. either side of this—say, from 1,150 to 1,210 deg. C.; yet it is still possible to pour castings as low as 1,060 deg. C. (but not sound). This fact makes it obvious that without proper temperature control the majority of castings will have a tendency to err on the too-low side rather than on the too-high, for the dangers of casting too high are known and exaggerated, and the outward signs, such as greater amount of fume and greater liveliness, are readily recognisable; whilst there are no such obvious pointers to indicate the low side of the correct casting temperature. This is further proved by the furnaceman's errors, which are more often on the low side. The time factor is against it to commence with. Every second the crucible stands, it is cooling. The skimming may be protracted; there may be a slight delay for someone or something; or where there is small work being cast, an urge to cast just another mould if there is metal left over.

The practical effect of this is rather contradictory. If the castings be not subjected to pressure tests, then probably the deleterious effect may not be very noticeable to the casual observer. In fact, the castings may appear quite sound with a greater freedom from "piping." If subject to pressure tests, however, the greater microscopic porosity will definitely be shown up in a high percentage of failures. Where a casting is poured below its correct casting tem-

perature, the metal does not remain liquid long enough to "feed" satisfactorily. This is due to the casting setting as a whole almost immediately the mould is filled, caused by the insufficient amount of superheat being lost by the metal on its travel through the mould.

The correct casting temperature ensures sufficient superheat, so that a more progressive solidification takes place. The first metal running through the mould undoubtedly gives up a considerable proportion of its superheat to the walls of the mould; the portion of the casting farthest away from the runner is therefore the coolest, and solidification commences there. There will then be a temperature gradient throughout the mould, from the point furthest away from the runner, to the last metal poured into the head.

If sufficient superheat has been given, there will then always be sufficient hot "live" metal adjacent to the portion undergoing solidification to follow up and "feed." It only remains, then, to ensure that the runner and head is ample, and that the ingate is large enough to remain liquid and allow the last portion of the casting to feed from the runner; otherwise, when the gate is cut off, a "pipe" running into the casting will be disclosed.

Cold-Cast Castings

Castings poured too cold do not exhibit "piping" at the gate. The unsoundness is mainly distributed throughout the casting. Machining an outside face may reveal nothing, but a pressure test will probably show it up. A section of such a casting, when subjected to a "deep etch," will clearly reveal its porosity to the naked eye, whilst it is equally obvious if a section is examined under the microscope. Strong, sound, dense gunmetal, correctly cast, and fairly rapidly cooled, exhibits a definite dendritic structure.

Fig. 4 represents the structure of sound material of 21 tons per sq. in. and 40 per cent. elongation. Weak, low-density gunmetal, seen under the microscope, looks weak, having none of the strong interlocking dendritic arrangement. This type of structure, as shown in Fig. 5, is usually accompanied by actual voids or cavities—giving porosity under test, and being of low specific gravity, the example shown having a specific gravity of only 8.2. Some years ago, in a similar Paper, the author published a diagram indicating the type of runner head usually associated with the three phases—cast "too hot," "normal" and "too cold." Fig. 6 illustrates this diagram.

Gas Evolution

In this connection it should be noted that the material poured too hot does not always indicate itself as shown in this way. The qualification is needed that, when this type of head is found, it indicates that the metal has, in addition, been damaged during melting by the absorption of excessive oxides and gas. This phenomenon can be observed, apart from any temperature effect, in a casting poured from correctly-melted metal which has been poured into a ladle with a damp lining. The steam evolved is split up into hydrogen and oxygen; the oxygen causes severe oxidation, and the hydrogen apparently dissolves. On solidification this is released, and the effect on the casting can be imagined. This type of head, therefore, is really evidence of the gas evolution which takes place at the moment of solidification. Instead of a normal shrinkage due to feeding, there is an expansion due to the gas evolution. An example of such a runner head is shown in Fig. 7. This was from a large valve, which required about 800 lbs. of metal to cast. Two 400-lb. crucibles were correctly melted and withdrawn from the furnace at a temperature just sufficiently high enough to give the required casting temperature after transferring to a ½-ton ladle. Unfortunately, the ladle was not perfectly dry, and a wild ebullition took place. After a few moments this ceased, but the damage was already done. After standing a few moments on the completion of pouring the mould, the runner head suddenly commenced to rise. Fig. 7 shows a section cut through this head. Apart from the actual gas bubbles, the rest of the material appears to the eye, to be fairly sound. It is only when it is subjected to a deep etch, however, that the full extent of the unsoundness is revealed. This is shown in Fig. 8.

A considerable spongy, gassy, area is seen in the centre, and above this is an actual gas bubble. It will be noticed that the chilling of the metal on the top of the head has restricted the escape of gas, and caused the gas to push its way through the pasty solidifying metal out to the corners and sides. The gas evolution increasing as the solidification proceeds, has caused a gas pressure to be built up, and this literally blows the head up. It should be noted that with this type of head is almost invariably associated the appearance of beads of "tin sweat" (this being the delta or tin-rich constituent). This, being the last constituent to solidify,

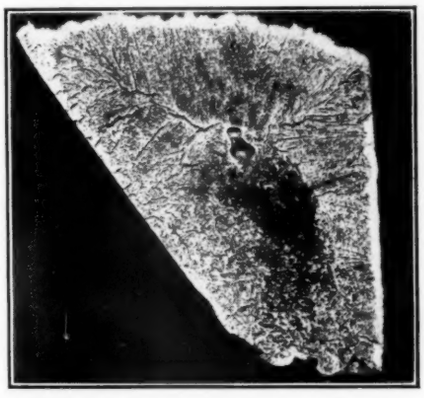


Fig. 8.—On Deep Etching the Serious Character of the Defect shown in Fig. 7 is Revealed.

accumulates at the centre of the section; but the gas pressure appears to force it up and out, and, travelling by way of the gas fissures, is found round the outside rim of the head. An actual specimen cut from this head had only a specific gravity of 7.8. Admittedly the head is the worst part of the casting, but it is obvious that no casting attached to such a head could possibly be expected to stand much in the way of a pressure test. The unsoundness is distributed throughout all sections, and although on machining it may not appear very "loose" or porous, yet a section "deep etched," or examined under the microscope, will immediately indicate the reason for failure. As stated, this particular illustration was the result of a damp ladle, but the same effect results when metal is melted under bad conditions, giving rise to oxidation and excessive gas absorption.

(To be concluded.)

(Concluded from next column)

this condition to be made possible. The extensions now in hand would facilitate manufacturing conditions and would involve increased employment.

Many of the guests visited the factory on the Sunday morning, and were impressed with the progress recently registered. The core shop has been mechanised, a core blower by the August Borrmann machine and two new drying stoves by Foundry & Engineering Company, Limited, of West Bromwich, have been installed. The present overcrowding in the fettling shop will soon be obviated by transferring this work to a new building which is rapidly approaching completion.

Effect of Mould Condition upon Cast Iron

The effect of moisture content of the mould upon the mechanical properties of cast iron has been studied by Dr. A. Väth.* Moulds with varying moisture content were prepared into which, at about 1,350 deg. C., a high-phosphorus iron, containing carbon 3.2, silicon 2.4, manganese 0.7, phosphorus 1.4, and sulphur 0.1 per cent. was cast. The castings were plates 0.28 and 0.6 in. thick and round bars 0.8 in. dia. With increasing moisture content (from 0 to 8.3 per cent.) the transverse strength increased from 20.4 to 22.4 tons per sq. in. At the same time the Brinell hardness increased (by about 15 units) as well as the number of graphite flakes per unit of area. The deflection fell from 0.121 to 0.102 in., indicating that cast iron becomes more brittle when cast in wet sand moulds. This is chiefly due to the coarser form the phosphide eutectic assumes at higher cooling rates.

In these and other tests it was found that with sections thinner than 0.4 in. the scatter of the hardness determinations becomes larger with increasing moisture content of the mould. At the comparatively rapid cooling which prevails in these sections, solidification is liable to pass from the stable to the metastable form, which is characterised by the finely divided state of the graphite embedded in a ferritic groundmass containing little, if any, pearlite. It is to the presence of this intermediate zone that the variations in hardness must be attributed. This ferritic zone, the formation of which is dependent upon the chemical composition and the degree of superheating, can also be the cause of the thin sections being softer than thicker sections. With a highly superheated iron the inner layers of sections thicker than 0.4 in. contain, in most cases, more pearlite, are harder and more difficult to machine than the outer layers. The relatively slight increase in hardness which was obtained in the mould of the highest moisture content shows that the danger of hard spots is not intensified in wet sand moulds, provided the moulds are properly made.

* "Die Giesserei," 1934, Nos. 1-2.

The Qualcast Dinner

The fourteenth annual dinner of that progressive Derby foundry concern, Qualcast, Limited, was held last Saturday. The whole of the company's works and office staff, over twenty-one years of age, the firm's suppliers, customers and friends all meet together on these occasions to demonstrate, under the happiest conditions, that they each have a function in carving the destiny of any industrial organisation.

Mr. V. Jobson presided, and was supported by his co-directors—Mr. C. Bigg and Mr. Richardson. Major Briggs, from the Australian company, was happily in England on leave. The Institute of British Foundrymen was represented by two of its Past-Presidents, Mr. John Cameron, J.P., and Mr. V. C. Faulkner, Editor of The Foundry Trade Journal. The company's suppliers were represented by Mr. H. Coggan (August's), Mr. D. H. Wood (Constructional Engineering Company) and Mr. P. Boyle (Swift Levicks, Sheffield), whilst the customers were represented by Mr. P. G. Donald, and many people prominent in the automobile industry.

Mr. Jobson, having presented a number of clocks to women and men with 10 and 20 years' service respectively, said that last year every record had been broken. Included in the records were weight of metal melted, efficiency of each individual, value of sales, and average wage paid per employee. Whilst making no definite promise, Mr. Jobson said it was his intention to accord a week's summer holiday with pay to his workpeople. Naturally, everybody must maintain or increase his or her efficiency to enable

Refractories in American Cupola Practice*

By E. C. Bales

The firebrick lining in cupolas should be of considerable interest to every foundry operator, because a good lining will mean longer service, more efficient cupola operation and lower maintenance costs. Cupola blocks have been made for a great many years in all of the firebrick-producing districts, but only within recent years has the subject of cupola linings been given serious consideration by refractories engineers.

Some firebrick manufacturers have maintained the opinion that cupola blocks made of low-heat-duty fireclays give the best service, but this is far from the truth. It has been established within recent years that the very highest grade cupola blocks are not too good for modern cupola operation. This is particularly true in the small cupolas which came into such general use during the American depression, and it is likewise true in the larger cupolas that pour continuously. The firebrick manufacturers who are having the greatest success with their cupola refractories are those who have made a thorough study of actual service conditions in cupolas, and who have developed a block especially suited for this service. Foundrymen are no longer demanding low-priced linings because they have learned that those blocks which are the cheapest in the long run may have a slightly higher initial cost.

Cupola blocks are made by four different processes: hand-moulded, hand-moulded and hand-pressed, stiff-mud and machine pressed, and by dry-pressing. Assuming that the blocks are all made from the same raw materials, the following general remarks will apply to the blocks made by the indicated manufacturing process:—

(1) Hand-moulded blocks are rather porous, somewhat fragile, not accurate in shape or size and require thick joints when being laid up. Their resistance to slag erosion and abrasion is very poor, but they have good resistance to heat shock or thermal spalling. They give fairly good service in cupolas where small heats are run and where pouring is done intermittently. They will not give satisfactory service in production foundries where pouring is continuous.

(2) Hand-moulded, hand-pressed blocks are also porous and fragile, but they are fairly uniform in size and shape and can be laid up with thinner joints than blocks made by the "hand-moulded" process. Their resistance to slag erosion and abrasion is only fair, but they also have good resistance to heat shock. They give satisfactory service in those cupolas where moderate heats are run intermittently.

(3) Stiff-mud, machine-pressed blocks will give better service in cupola operation than those made by any other method. They are very hard and dense, uniform in shape and size, and can be laid up with very thin mortar joints. They have very high resistance to slag erosion, and are so resistant to abrasion that in the abrasion zone they will last twice as long as blocks made by any other process. Because of their extreme density, they are more likely to spall from heat shock than the porous blocks, but no trouble will be experienced unless the cupola tender uses water to cool the lining after the bottom is dropped. They give excellent service in small foundries where pouring is done intermittently, and they are the only type of block which gives universally satisfactory service in continuous-pour production foundries.

(4) Not many blocks are made by the dry-pressed process. They give poor service in cupola linings because of their high porosity, and low resistance to abrasion and slag erosion.

Cupola Service Conditions

It is now generally agreed among metallurgists and refractories engineers that the following factors of destruction determine the life of cupola linings:—(1) Intense heat in the melting zone, (2) chemical erosion by the flux and slag, (3) cutting action of the blast, (4) abrasion by coming-down charges, (5) spalling and (6) breakage loss caused by chipping out the cupola.

Four Zones

For the purpose of studying further the results of the factors given above, the cupola may be divided into four parts:—(*a*) The zone above the charging door, (*b*) the zone between the charging door and top of the melting zone, (*c*) the melting zone proper and (*d*) the crucible. The conditions above the charging door are not at all severe and need not be considered here.

That part of the lining between the charging door and top of the melting zone is subjected to severe abrasion, especially if the charging is done carelessly, and this abrasion is a very important cause of failure. Near the top of the melting zone the blocks are not only affected by abrasion, but they are subjected to a high temperature, and particles of slag and molten iron are blown against the lining, which may cause small flakes of the brick to spall off.

In the melting zone, the blocks are subjected to a very high temperature, chemical erosion from iron oxide, coke ash, flux and the slag, and to thermal shock. The latter is very severe when the bottom is dropped and water is turned on the lining.

In the crucible, the lining is subjected to high temperatures, molten iron (which may cause trouble if it is badly oxidised), and thermal shock.

Means of Obtaining Longer Service from the Cupola Lining

The cupola operation has a great deal to do with the life of the firebrick lining, and unless it is done properly, no firebrick will last very long. The life of the lining in the melting zone varies over wide limits, and as determined by a recent questionnaire, this may be from 9 to 525 hrs. Of course, the "burning away" of the lining above the tuyeres is normally proportional to the melting-zone temperature and the duration of the heat. Extreme cutting in one spot, which usually occurs over a small "bridge" or between tuyeres, results from excessive oxidation at that point.

The nature of the mixture used in the cupola has considerable bearing on the life of the lining. A high percentage of steel scrap with its higher melting temperature decreases the life of brick in the melting zone. The steel scrap should be in small pieces so that it will not divert the blast against the lining.

The fluxing material is also important, and limestone and fluorspar, if used, should be kept at least 6 in. away from the lining. "Purite" (soda ash), although it does have a glazing effect on the brick, is so effective in forming a fluid slag and in clearing out corrosive slag, that its use in the cupola cannot be considered as detrimental to the lining.

Important factors in determining the life of the lining are the size of the heats melted, the length of time the cupola is operated each day, and the temperature of the metal when tapped. One of the greatest causes of trouble with the brick lining in the melting zone is an excessive blast. A high-pressure blast will oxidise some of the iron, and the resulting iron oxide is very corrosive to the lining. For this reason, a volume meter is far more reliable than a pressure gauge.

The cupola lining can be kept intact much longer than usual, provided the last charge is not coked, and the blast is shut off as soon as a white heat is reached. More firebrick are "burned" in the cupola at this time than at any other period because the blast works directly on the lining. The blast is not needed after the stock turns white, as the bed will melt any small amount of iron that may be left.

The type of product manufactured has a great deal to do with the life of the lining. Malleable castings made directly in the cupola are severe on the lining and a more refractory block is required than is the case where only grey-iron castings are made. This is due to the higher operating temperatures, and because considerable steel scrap is used in malleable mixtures, as well as a smaller quantity of coke. The slags from malleable cupolas are usually "foamy" and of a dark blue colour, showing that they contain considerable iron oxide. Such slags are corrosive to the lining, whereas slags of a greyish-green colour and of a hard glassy nature are comparatively easy on the lining.

Daubing Materials

In large, continuous foundries the 6-in. lining in the melting zone may be completely "burned out" each day, and it is probably more economical to replace the lining with blocks instead of patching and daubing. Where only part of the lining is "burned away" it is decidedly good practice to patch with 9-in. brick and No. 1 splits or a good daubing mud.

There are probably as many daubing mixtures as there are grey-iron foundries. Some of them prolong the life of the lining, while others actually help to destroy the lining. The following mixtures are giving good service in foundries, and they help to preserve the lining:—

Mixture No. 1.—One part plastic fireclay (fusion point at least Cone 26) and two parts white silica sand (waste sand from the sand-blast machines is excellent for this purpose provided it does not contain too much iron scale).

Mixture No. 2.—Four parts plastic fireclay (fusion point at least Cone 26) and six parts crushed firebrick—all through 10-mesh screen (old firebrick from the cupola lining can be crushed by placing in a tumbling barrel containing a few pigs of iron).

Either of the above mixtures should be thoroughly mixed with enough water to make a stiff, plastic mud. The mixing can be done in a small muller machine such as is used in mixing moulding sand. Never use river sand, moulding sand, yellow loam or blue shale in daubing mixtures. They are not sufficiently refractory and will cause the daubing to melt, the patching brick will slide down the lining and a bad "bridge" may develop.

* From the Bulletin of the American Refractories Institute. The Author is Vice-President of the Ironton Fire Brick Company, Ironton, Ohio.

Iron and Steel Output in February

The National Federation of Iron and Steel Manufacturers state that there were 90 furnaces in blast at the end of February, an increase of five since the beginning of the month, seven furnaces having gone into blast and two furnaces having ceased operations. Production of pig-iron in February amounted to 414,400 tons, compared with 441,300 tons in January and 270,800 tons in February, 1933. Since February was a shorter month than January, the reduced production represents an increase of 4 per cent. in the daily rate of output. The production includes 96,800 tons of hematite, 216,900 tons of basic, 88,700 tons of foundry and 5,500 tons of forge pig-iron. The output of steel ingots and castings in February amounted to 707,500 tons, compared with 711,000 tons in January and 482,700 tons in February, 1933.

Brassfounding Developments

Messrs. Manley & Regulus, Limited, brassfounders, of Wolverhampton, have purchased the Star Motor Company's works at Bushbury, and intend to transfer their works at present at Birch Street, Mander Street and Penn Road. A circular letter to the shareholders states that the "present works have gradually been increased up to their full capacity, and are unable adequately to cope with orders on hand." The directors intend to start the manufacture of hot pressed brass work as soon as the new works are equipped, and to meet the cost of development are proposing to make a new issue of capital in the near future.

A Projected British Foundry School*

By J. G. Pearce, M.Sc., F.Inst.P., M.I.E.E. (Director, British Cast Iron Research Association)

Introduction

The art of founding is of ancient origin, and, indeed, in the foundry modern engineering began. The industry forms an integral part of the structure of every industrial country, and its importance in future is unlikely seriously to be challenged, for, with small exceptions, all metals, whatever their form, size or application, during the process of refinement from the ore to the finished product, pass through the cast state. The scientific and technical importance of the subject thus transcends even that of the founding industry itself, by which is usually understood the industry that makes cast metals for use as such in the cast state, since some properties of wrought materials determined during casting may persist through the refining process.

Partly on account of its ancient origin, which makes for conservatism of outlook and personnel, and partly on account of the extraordinary complexity of many cast metals, which has hitherto led metallurgists to prefer the study of the more refined, and hence scientifically simpler, wrought materials, founding has felt the effects of scientific research and development at a later stage than the engineering and heavy industries of which it is part.

The founding industry proper comprises the casting of grey iron, white iron, malleable cast iron, steel and a wide range of non-ferrous metals. Considered economically, the founding of cast iron is of preponderating importance, both in tonnage output, value, number of men employed, number of establishments concerned. An estimate made by the author some years ago has been widely quoted, that the output of the founding industry in the United Kingdom in a normal year is about two million tons, and has an approximate value of forty million sterling. The Census of Production for 1930, which for the first time included founding as a separate entity, generally confirmed this estimate, bearing in mind the limited number of establishments covered by the Census and the depressed state of the industry at that time. A comparatively small percentage of this output, possibly 5 per cent., although there are no definite figures, consists of malleable cast iron, white-heart and black-heart. The output of steel castings in a normal year may also be taken as about 8 per cent. of the total. No separate statistics appear to exist for the production of non-ferrous castings, principally brass, bronze and aluminium. These sections are, of course, of enormous importance technically and economically to industry as a whole.

International Contributions

Founding is frequently spoken of as an art and remains in the engineering industry almost the last home of the pure craftsman. The traditional character of the industry in this country, combined, possibly, with British apprenticeship methods and the high intelligence of the British worker, have placed foundry craftsmanship in this country on a plane above that of other industrial countries, and craftsmanship is now regarded as the major contribution made by this country to founding, the production of purely artistic castings excepted. The American contribution may be regarded as the development of labour-saving appliances and equipment, facilitating quantity production and continuous production. The contribution of continental countries, particularly Germany, may be regarded as that of close metallurgical control. The interchange of published information and general economic development is rapidly minimising these differences as far as this country is concerned.

Developments both in the industry and outside it are reacting to the disadvantage of Great Britain, for they tend to nullify special advantages arising from geographical compactness, tradition and highly-skilled labour which this country has so long enjoyed. Furthermore, they demand skilled technical and scientific control. The author has for several years stressed the importance of developments which have been made abroad, particularly in the United States of America and in Germany, and the stream of improvements emanating from those countries has not only placed Great Britain at a disadvantage with respect to priority in time, but has involved payments in the form of licence fees and royalties to those countries. These developments have their origin in the application of science to the industry and to the gradual permeation through the industry of scientifically-trained men.

So far from declining, metallurgical development is expanding the applications of cast products, which are used now on their merits rather than because they are cheap. In particular, research in such fields as fatigue and creep stress is showing the simple stable cast metal favourably compared with wrought products of similar compositions.

Research Developments

The establishment of the British Cast Iron Research Association was a step made by the industry in this country towards formulating a distinctively British contribution to this development, so far without parallel in other countries. The difficulties of securing the necessary financial support in such a conservative industry have been considerable, and these have been greatly increased by its lack of organisation. There are possibly two thousand establishments in this country where the founding art is practised. They differ widely not only in size and in the character of the work carried out, but also in their relations with the industry as a whole. A large group of establishments exist as parts of engineering works which conduct foundries to ensure the supply of their own castings. Foundries are also connected for economic reasons, with iron and steel works and blast furnaces. There are also large and important establishments making castings and finishing them completely for the market, in the form of builders' products—baths, stoves, grates, etc., and other specialised castings. Finally, many works have small maintenance foundries of comparatively little importance, for the purpose of producing such odd repair castings as may be required from time to time, and many small jobbing and repair foundries exist.

Foundries may thus be classified roughly with respect to character of product, as jobbing (that is, prepared to make whatever castings may be required for the trade, irrespective of the number of each, which is generally small), or specialised (which lay themselves out to produce one type of casting only, whether it be, for example, automobile cylinders, piston rings, parts for lawn mowers, typewriters, or electric machinery). With respect to their relationship to the trade, they may be classed as detached, that is, independent of any other works, or as dependent, forming part of a larger organisation, such as an engineering works or iron and steel plant, the demands of which they exist to satisfy, or the products of which they employ. Some foundries are large and some very small, with every intermediate size between the extremes; some deal mainly with heavy castings and others with castings light in weight. They are in general capable of being grouped according to whether they make grey-iron, malleable-iron, steel or non-ferrous castings, but here, again, many foundries make castings in at least two and even three of these categories. Foundries, therefore, cannot be classified on any basis which places them all in mutually exclusive groups. The grouping of foundries in larger units for economic reasons has not substantially altered this situation.

Foundry Personnel

The personnel of a foundry naturally differs widely from case to case. The simplest and smallest foundries are operated by moulders, coremakers, furnacemen, under the supervision of a foreman, and as the size increases so the variety and responsibility of executive posts increases. A large foundry may have a manager, with assistants, specialised staffs for purchasing, selling, advertising and publicity, testing, inspecting, designing and so on, all fundamentally concerned with castings, and in many cases a patternshop forms part of the foundry organisation. Where a foundry is part of a large works, these functions are still performed, but are merged with similar ones carried out for other parts of the organisation. Technical developments in recent years have multiplied the number of specialised posts available. The last few years has also seen the growth of an important industry concerned with the design, manufacture and installation of equipment for facilitating foundry production, especially for continuous and quantity production and with the supply of foundry materials. The staffs of firms concerned are again fundamentally concerned with the advancement, economic and technical, of the founding industry. No detailed statistics exist for labour employed, but it is probable that the industry employs directly in all grades about 120,000 workers, and as a first approximate estimate it is suggested that there are in the industry a thousand posts, the men occupying which might profitably have the highest training the industry can give. The number of apprentices and learners may be taken as 5 to 7 per cent. of the number of skilled workmen. There are approximately five or six moulders to every coremaker, although some men are engaged on both these tasks. There are roughly three moulders and coremakers to each patternmaker.

This brief summary gives some idea of the character and size of the founding industry, the progressive future development, of which is the main object of any scheme of research, development and education or training.

Methods of Recruitment

There is no recognised course of training or channel feeding the higher posts in the founding industry, nor is there any clearly-defined channel of promotion. A comparatively small number of university-trained men, mainly graduates in metallurgy, have entered the industry, but a much larger number come from the high schools. In the main, the higher posts are filled by promotion of men who have shown their capacity in practice and who have, in general, acquired technical knowledge by part-time study, or, in engineering works, by transfer from other departments. Few, if any, foundries are in a position to train men for their own requirements, beyond the training afforded by day-to-day experience on work in hand.

During the past few years the author has been repeatedly approached by founders for men required as foundry engineers, metallurgists, foremen and managers, and also by men requiring posts. At the present time the only way in which a foundry can obtain a man with experience is to take him away from another foundry. The author's experience over a long period of years has been that it is a much more satisfactory plan for a works to train its own men for its own

* A Paper read before the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, Mr. E. J. Lewis, presiding.

XUM

work. The present scheme offers a means for doing this, made essential by developments in the industry, and which will assist in maintaining the prestige of the industry at home and abroad. It represents an attempt on the part of the industry to raise its personnel to a higher level.

Education and Training

Until a few years ago foundry education and training in Great Britain were in an unsatisfactory condition.* Classes in foundry work were held at a number of technical schools and colleges throughout the country, but difficulty was experienced in securing the attendance of those actually engaged in foundries, and the classes were in the main used by students of engineering who wished to obtain some general knowledge of foundry processes. However useful such provision may be for conveying the elements of practical training to those outside the industry, it is now generally acknowledged that it is difficult, if not impossible, for a technical school adequately to teach the art and practice of founding. The time available is too limited, the equipment is too scanty and often obsolete, and difficulty is often experienced in securing the services of the right type of instructor. Furthermore, the industry is changing very rapidly, and it is virtually impossible for a technical school to keep pace with these changes. The only place, in fact, where adequate practical training can be acquired is the foundry itself. With respect to the science of founding, which has grown enormously in recent years, the technical schools can, and do, carry out excellent work, and it is fully recognised that they undertake best the teaching of principles underlying the practice of the art. The differentiation of students according to their needs (separating foundrymen from engineers and other students) and the development of a clear conception of those needs (providing separate courses for the operative and the technical and administrative grades), would do much to enhance the value of technical school courses still further.

The metallurgical degree courses at the universities normally cover the whole field of metallurgical practice and the time actually devoted to founding is small. This could with advantage be greatly increased not only in metallurgical courses, but in degree courses for students of engineering (civil, electrical, mechanical, marine, automobile and chemical), architecture, building and mining, as it is important that students who aspire to responsible positions in industry should be able intelligently to test, specify, inspect, purchase and use cast products.

Existing Facilities

Some years ago systematic steps were taken by various representative bodies in the industry, notably the Institute of British Foundrymen and the British Cast Iron Research Association, to build up a national scheme of foundry education. A national scheme seeks to make specific provision for those actually in the industry, who, of course, have first claim on its consideration, and to arrange that the same standard of instruction shall be available irrespective of the accidents of local circumstances. It aims at providing nationally-recognised, as distinct from local certificates. The first consideration was the operative, the moulder, coremaker and patternmaker. Arrangements were made, in conjunction with the City and Guilds of London Institute, for examinations in patternmaking and in foundry science and practice. Two examinations are now held yearly in patternmaking, intermediate and advanced, and one in foundry practice and science. Many technical schools throughout the country now provide courses leading to these examinations, and the number of students taking them has grown in a very satisfactory way. The certificates are endorsed by the Institute of British Foundrymen. The courses and syllabuses are supervised by an Advisory Committee nominated largely by the industry.

The next step was the institution of a national certificate, in conjunction with the Institution of Mechanical Engineers, for what might broadly be described as the technical grades in the industry, foremen, charge hands, estimators, inspectors, testers, chemists, metallurgists and the ambitious operative who seeks higher responsibilities, or who wishes to learn more about the basis of his craft. The production of castings is essentially an engineering job and the student takes the Ordinary National Certificate in mechanical engineering and, as far as possible, in those subjects, notably chemistry and physics, which are fundamental to the study of metallurgy. The Higher National Certificate, roughly equivalent to university degree standards in the subjects with which it deals, offers the student the opportunity of a measure of specialisation in foundry work. This certificate is also endorsed by the Institute of British Foundrymen. These national certificates enable the holder, when certain other conditions are met, to apply for election to a professional body, such as the Institution of Mechanical Engineers, and thus to acquire a professional qualification. In the course of time membership of the Institute of British Foundrymen may enjoy a similar status, and already is favourably regarded by many employers.

It has been recognised from the beginning that these foundations needed to be completed by a superstructure in the form of a course offering instruction of the very highest order for those who have marked themselves out for the highest posts and greatest responsibilities the industry has to offer, as foundry managers, chemists, metallurgists and engineers. Such a scheme was foreshadowed by the author in lectures to teachers at Merton College, Oxford, in 1929, and Loughborough College in 1931, and a scheme was framed in November, 1932, and in that month a discussion on its possibility was opened with the Board of Education. The scheme was not made public partly because it was desired to see first what official support would be offered to the scheme, and partly because of the depressed state of the industry at the time. The Association's Education Committee, under the chairmanship of Mr. E. R. Briggs, M.Inst.C.E., of Rugby, took the matter up vigorously and the scheme was considered by the Council and ultimately unanimously approved and commended to the industry at a meeting held on February 28, 1934.

Research and Education

The British Cast Iron Research Association has from its inception been keenly interested in foundry education and training. While it is, in fact, actually empowered by its Articles to undertake educational work entirely on its own responsibility, it has been content to co-operate with other representative bodies. As the Association is the only body of its kind in the country exclusively devoted to founding, and as the industry is predominantly concerned with cast and malleable iron, it is natural that the Association should provide the initial impetus for such a scheme. In this it has had the sympathetic support and interest of the Department of Scientific and Industrial Research.

The close connection between research and education is fully recognised in the universities and technical colleges, and the work of the Research Association covers not merely research work but what is conveniently known as development work, that is, the application of the results of research and knowledge to the industry. The popularisation of this knowledge among members is essentially educational in character and consequently the Association has been compelled to embark on work which is broadly educational. For example, the Association has had considerable experience in organising meetings of members throughout the country to discuss and explain work in progress, experience which culminated in October, 1933, in the organisation of a Study Course for the purpose of surveying and reviewing the work of the Association and its application. This course was attended by no less than 170 members, who for three days were fully engaged in hearing lectures, taking part in discussions and attending laboratory demonstrations and works visits. The Association has in a number of cases received apprentices, nominated by members, in the laboratories for the purpose of receiving training in various branches. The Council also recognises the responsibilities of the Association to the industry as a whole, and during the past few years a number of technical and scientific Papers have been given by members of the staff to metallurgical institutions in this country and elsewhere. The proper application of research to practice is recognised to depend largely on the existence of a foundry personnel properly educated and trained in the art and science of founding.

It is necessary to emphasise, however, that the school, proposals for the establishment of which are now outlined, will be completely independent, financially or otherwise, of the British Cast Iron Research Association, and while it is hoped that the contact between them will be of the most friendly description, the new school will have its own governing body, the Association taking its place as one of the constituting bodies concerned.

Sheffield University Degree Course

Reference should also be made to the proposals for the establishment at the University of Sheffield of a degree course in founding, made in March, 1933, through Prof. J. H. Andrew.* The University then announced its willingness to provide degree and associateship courses for students of metallurgy desiring to specialise in founding, subject to the industry furnishing the necessary funds. The University requires the sum of £1,500 per annum, guaranteed for a period of seven years. The relationship of this course with the Association's proposals has naturally been the subject of careful consideration. It has been found that the two proposals do not in any way overlap; they are essentially different in aim, and this is fully recognised by the sponsors of the two schemes. The University course is intended for young men who would normally expect to take a degree course, but who have not yet entered the industry and who believe that a specialised founding degree would be of assistance to them. The Association's proposals are intended solely for those actually engaged in the industry and who are already committed to it. As will be indicated later, the industry is for this scheme only required to furnish the sum of £500 per annum and, as the course lasts for one year, no lengthy period of guarantee is required; neither is any large outlay required for capital expenditure on equipment, for reasons which will be outlined below. The Board of Education has considered the two schemes and has expressed the view that they fit into and supplement one another. The author represents the British Cast Iron Research Association on the Committee which is promoting the Sheffield scheme, and the Institute of British Foundrymen, and in particular the Committee sponsoring the Sheffield scheme, will doubtless be represented on the governing body of the school proposed by the Association. The Sheffield Committee has already expressed its approval and sympathetic support of the new scheme.

Regional Efforts

Individual technical colleges have installed excellent equipment and established very satisfactory courses for foundrymen, notably at Birmingham, Middlesbrough, Falkirk, Rugby,

Mr. A. Abbott's "Education for Industry and Commerce in England" is an admirable survey of the Development of Technical Education (Oxford University Press, 1933).

* See FOUNDRY TRADE JOURNAL, March 16, April 13, November 23, 1933, and February 22, 1934. See also V. C. Faulkner, FOUNDRY TRADE JOURNAL, October 6, 1932.

Wolverhampton and at the Sir John Cass Institute in London. Loughborough has excellent foundry equipment used in its ordinary courses. None, however, is in a position to offer training of the highest type on a full-time course and, indeed, the prospective demand does not require the establishment of more than one such school for the whole country. The detailed proposals for such a school, to be governed by the industry itself but in full co-operation with the existing educational machine, can now be considered. They are, of course, subject to any modifications which the governing body may in due course see fit to make.

The New School: Its Status

The school will form a new body entirely independent of existing representative bodies in the industry and of the universities and local education authorities. In this respect it will be unlike any other school for industrial training in the country. It will be governed by a committee nominated by the representative bodies in the industry (trade associations, technical and scientific societies and research associations) and others who offer the necessary financial support. It will grant to successful students a national and State-recognised diploma and no other school will be established to grant a similar diploma, which will thus have a national and nationally recognised value. The course will be a full-time course of one year's duration.

Aim of the School

The school will not attempt to afford practical training, which can only be acquired in the foundry, and suitable practical knowledge will be a condition of admission, which will be confined to those actually engaged in the industry. The school will aim at furnishing men who have already gained this practical experience, who have some technical knowledge through part-time or full-time study, and who show promise and ability to undertake responsible work, with the most advanced information and knowledge in the science and art of founding that the country can offer. It will appeal to the foundry manager, the foundry engineer, the foundry chemist and the foundry metallurgist, to men who aspire to these posts, and to men in all other posts for which this type of training is a recommendation. It is intended that the course shall cover the founding of grey iron, white iron, malleable cast iron, steel and non-ferrous metals, and that it shall appeal equally to large and small foundries, light and heavy foundries, attached and independent foundries, jobbing and specialised foundries, as all these types are likely to remain part of the permanent industrial structure of this country.

Location

It is proposed to establish the school in Birmingham, which is geographically, industrially and educationally very suitable. The city is easily reached from all parts of the United Kingdom, and is centrally situated. It is the centre of the most densely-populated foundry area in the country, an area which includes blast furnaces, ironfoundries of all types, for cast and malleable cast iron, non-ferrous foundries of all types and steel foundries. The foundries of the area are modern in character and the area has been advantaged by the so-called southern drift. The city possesses a civic university of the highest rank, which has the largest Department of Metallurgy of any university in the country, now in charge of Prof. D. Hanson, who is well known for his work on cast iron, as was his predecessor, Emeritus Prof. T. Turner. It also has a large and centrally-situated technical college capable of providing instruction up to university degree standard. While, of course, final arrangements will depend upon the acceptance of the scheme by the industry, it is anticipated that no difficulty will be experienced in arranging for the new school to be housed in the Central Technical College. No separate building scheme is contemplated, for the number of students to be dealt with would never justify such a scheme. Furthermore, there are advantages in associating the school with a larger institution, as teaching in certain subjects can be readily provided for. The Director of Education for the city, Dr. P. D. Innes, is responsible for what is probably the largest scheme, or at any rate one of the largest schemes, of educational administration in the country. The Principal of the Technical College, Dr. D. S. Anderson, has charge of an institution complete in every respect, and the Department of Metallurgy, known to hundred of students of the subject and now under the direction of Dr. F. Johnson, is admirably equipped for the purpose in view. The city is also the headquarters of the British Cast Iron Research Association and the heavy section of the British Industries Fair. It can fairly claim, in view of its size and variety of interests, to be the industrial metropolis of the country.

Admission

The admission of students will be determined by the governing body, but it is probable that a start would be made with not less than ten students, and the maximum in attendance would probably not be allowed to exceed thirty. There will be no age limit for admission. It is anticipated that students will be required to pay a fee of about £30 for the course, which would last for a year. The cost of operation is estimated to be £2,300 per annum for the minimum number of students, increasing to £3,000 for the maximum. It will be evident that from sources other than fees, a sum of £2,000 per annum has to be furnished. In this connection, the Board of Education has expressed its interest in the scheme, and, subject to the industry furnishing the comparatively small sum of £500 per annum and to the required number of students coming forward, is prepared to consider furnishing such support as would enable the school to operate on a proper basis. The funds of the school will be administered entirely by the governing body. It must be understood that the support of the Board of Education is conditional upon the conditions mentioned above being observed, but the industry can be assured that the Board's support will be forthcoming if these conditions are met. The Board recognises that the new school is of an entirely new type having a much closer connection with the industry than is usual in this country, and, if the school becomes a success, it may stimulate the establishment of similar schools for other industries.

Since the school will not undertake practical training, it will be necessary that all prospective students should have had experience in a foundry and a minimum of twelve months' practical experience will probably be required. A definite standard of technical knowledge will also be required, and the existence of the craft certificate and national certificate schemes referred to above will make it easy for those who have not reached the standard of knowledge obtainable from courses for these examinations, to repair the omission by part-time study in their own districts. In this connection the school will co-operate with the technical colleges and schools, and it may be able to assist in the training of teachers and instructors in foundries.

Some students may take the course entirely on their own responsibility, but it is hoped that large firms will be willing to release promising members of their foundry staffs to attend the course and that the nominees of proprietors of small foundries will also attend.

Students from the Dominions overseas who normally wish to receive training in this country, and who will return home at its conclusion, will also be encouraged to attend, for such students take back to their own countries their impressions of British foundry material and equipment. Students will normally take the diploma examination at the end of the course, but a limited number of non-diploma students may be admitted, although they may be required to pay the actual cost of the course. No student will be allowed to omit any one section of the course.

Commencing Date

If sufficient students are forthcoming, the course will begin in October, 1934, or October, 1935. Prospective students are invited to communicate with the author, and, for the first year's course preferably before the end of April, 1934, so that the necessary arrangements can be made.

Relations with Other Bodies

The connection between the new school and the Board of Education has already been mentioned, and the Board will be represented on the governing body. It is hoped that an official relationship will exist, as indicated above, between the new school and the other representative bodies in the industry, being the scientific and technical societies, research associations and trade associations, and the representatives of those supporting the school will form the governing body. It is also hoped to exercise the fullest co-operation with the universities and technical colleges and in particular to be able to recommend to the latter students who wish to complete their preliminary studies before taking the course. Speaking broadly, the new school will not compete with or overlap with any other educational course in the country, and it is intended that its standard of instruction shall be higher than that available elsewhere and cover a field not dealt with by any existing institution.

Staff

As the school will form one homogeneous group of students, the school will form one class. It is proposed to appoint one permanent lecturer to take charge of the school, with one assistant, principally for laboratory instruction. The permanent staff will naturally be responsible for some of the lectures provided and the staff of the technical colleges, and possibly of the research associations, will also be called upon. The remaining lectures will be delivered, it is hoped, by men actually engaged in the industry and nationally recognised as experts in the fields with which they will deal. Any given specialist will not be called upon to deliver more than a few lectures per annum and will be remunerated for the expenditure of time involved.

Curriculum

A year's hard work is required to cover the ground desired. It is estimated that the course will consist of approximately 600 hours' lectures and 600 hours' laboratory work. In addition, each week a foundry visit will be arranged on which the student will prepare a report, and each session a visit to another foundry area will be paid.

As indicated above, the course will cover the founding of grey iron, malleable iron, steel and non-ferrous metals. It will deal with the history and development of the art of founding and the application to it of modern metallurgy; with the structure of the founding industry in this and other countries, the organisation and planning and adaptation of foundries, including mechanisation, with the raw materials, processes and equipment of the industry; with costing and delivery estimates and with foundry metallurgy, engineering and chemistry. The curriculum will aim at enabling students to prepare from a sketch or a casting a complete scheme of production for the quantity involved, to plan or modify a foundry for any given output in any line of work, and to enable them to assess the respective merits of different materials used for castings and the respective merits of cast and wrought materials.

(*Concluded on page* 202)

XUM

The Electro-Plating of Castings

JOINT MEETING OF LONDON FOUNDRYMEN AND THE ELECTRO-DEPOSITORS' TECHNICAL SOCIETY

(*Concluded from page* 184)

Temperature Control

Temperature control, as apart from the necessary careful melting of alloys, was another well-known cause of porosity. Although the pyrometer was now a commonly used tool in any well-regulated foundry, a surprising number of non-ferrous foundries still took chances with temperature. So much had been written about casting temperatures that it was not necessary to do more than point out that there were definite limits within which it was possible to obtain sound castings and outside of which porous castings would certainly be obtained. Whilst having the greatest respect for any experienced man who could prove himself to be a good judge of temperature by its appearance to the eye, or by the immersion of a piece of wood or a piece of brown paper, he definitely would not accept these methods as being as reliable as using a pyrometer. A great amount of work which reached the plating department was of a very light character, and must, in consequence, be poured from metal which was reaching the border-line in temperature. The human eye, or a piece of brown paper, was certainly not sufficiently accurate a means of ascertaining temperature—far too many variables could creep in and lead to a wrong estimate. That fact should be emphasised particularly in the pouring of bronzes, in order to avoid porosity. Far too many good moulds had been spoiled by incorrect temperature of metal and far too much hectic language had been used by the plater when castings poured from overheated metal had reached him.

Surface on Iron Castings

The causes of speckiness in iron castings were in most cases exactly the same as in the non-ferrous castings, namely, the human element and incorrect facing sand. It was as well to remember that a good percentage of iron castings subsequently plated had to be surface-ground, and some people might hold the opinion that as the article had to be surfaced the question of a very smooth skin was not quite so important. That, however, was quite wrong, for it would be found that the cost of grinding to a good clean surface might exceed the extra cost incurred in the foundry. A good standard mixture for securing quite a superior skin to light iron castings of $\frac{1}{16}$ in. to $\frac{1}{4}$ in. section was:—20 parts of cleaned and screened old sand; 5 parts of screened new sand and 2 parts of super-fine coal dust. The coal dust should be of very good quality, and the fineness was specified as having passed through a 90 mesh to lineal 1-in. sieves. Quite good results had been obtained from coal dust now being sold as pulverised fuel; in appearance and feeling it should be as fine as a good quality domestic flour.

The operation of dusting or printing might be carried out with plumbago, but greater care as to quantity must be experienced, otherwise what was known as "kish" would be created, and a bad surface result even to the extent of corrugations. The coal dust mentioned should only be used on castings with thin sections. On thicker work a coarser and cheaper coal dust could be used. Unless the correct fineness was observed on thin castings "pitting" might result, and the grinders or platers would again encounter difficulties.

Porosity

The question of porosity in iron castings was a vast subject, but almost everybody immediately outside the foundry industry classified any kind of a defect as a "blowhole." This of course was not correct, and in this connection he mentioned that owing to lack of metallurgical knowledge of designers or due to lack of consideration on their part, defects often creep into castings which may give trouble to the plating departments. Here, said Mr. Pierce, he was referring to porosity caused by contraction of the metal, which led to cavities immediately called "blowholes" by the uninitiated. This point called for particular care in very light castings such as used in the electrical industries for instrument parts and the like. Owing to the extremely thin sections in this type of casting the high silicon series of irons was used. Porosity or weakness in a casting of this type might be found breaking it at the junction of a thin section with that of a violent change, a practice so often indulged in by designers. In that case a defect might be obtained that could be embarrassing, not only to the plater but to most other users. Undoubtedly the foundryman producing castings for the electrical industry which had to give the necessary high-class finish so often required, was producing castings that were much more difficult to obtain than some of the better known high-class products of the founding industry.

Existing Conditions

Summarising the position of the production of castings required for electro-plating, Mr. Pierce said it was fair to assume that a very good quality casting, and very often a superlative quality, was required, and it should be remembered by the purchasers of these castings that they could not expect to buy them at fire-bar prices. If they wanted good castings they must be prepared to pay fair and remunerative prices for their requirements. There could hardly be a section of any industry in which price-cutting went on to the same extent as in small non-ferrous casting work. How often was it that some industrious and ambitious moulder saved a few pounds and embarked upon the stormy sea of foundry ownership? He commenced, faced with difficulties that made good production almost impossible. Because of the lowness of overhead charges and the fact that his material was, more often than not, that which a reputable founder would not buy, such a man was able to quote prices that made for general dissatisfaction. The buyer only obtained temporary satisfaction on the question of price and often found that it redounded to his discredit. Even that, however, did not prevent him from using the low price obtained against another possible producer with a view to cutting. Whilst, continued Mr. Pierce, he had known a good number of individuals who had made the attempt to become foundry proprietors, he did not remember many who still occupied that most exalted position! Generally speaking, they existed only for a while, just long enough to have served the purpose of being a menace to the industry. Their low prices, bad materials, lack of proper tools, and generally bad working conditions, made the production of good castings a sorry proceeding. A visit to some of these places to see the conditions under which the few employees worked, made it difficult to believe that factory inspectors ever visited them.

In conclusion, Mr. Pierce assured the electro-platers that no genuine foundryman wanted to make bad castings; he would very much prefer to make definitely high grade castings only, and the electro-plater should realise that the trouble was often probably not the foundryman's inability to do the work, but the fact that he was not being paid at proper rates. If the reply was that the foundryman was paid a fair price for his products and then failed, then the remedy was in the buyer's own hands. After remarking that, although Mr. Caplan had exhibited a few bad castings and that he himself had brought a considerable number of very good ones, Mr. Pierce expressed his thanks to Mr. Manning, of the Electro-Platers' Technical Society, a colleague in his works, and also to his employers, Messrs. Elliott Bros., Lewisham, for facilities placed at his disposal

The CHAIRMAN said that having listened to the two opening contributions he was more convinced than ever that joint discussions of this type were extremely useful in that they served to indicate the difficulties of the parties concerned. His only regret was that the purchasing agents were not compelled by Act of Parliament to be present at such discussions, because those who got out alive would be chastened in spirit, and probably foundrymen and platers would not in future have so many troubles, because it seemed to him that many of the troubles were not technical at all but economic.

An Anomalous Situation

MR. S. H. KAIN said he had rather mixed feelings at the moment, because quite recently he had listened to a Paper by Mr. Handforth, the metallurgist to Messrs. Napier, the aeroplane builders, and Mr. Handforth had opened his Paper by saying that he was writing in a spirit of undiluted admiration for the foundrymen, and, said Mr. Kain, he was hanging grimly on to that expression of opinion and trying to keep his self-respect! Mr. Handforth was not particularly interested in the system of competition bids, but he was entirely interested in buying metallurgically for quality. That was a very different thing from getting work done at what was called rock bottom prices and expecting to get the best article. Many years ago the Admiralty, after a number of years of bitter experience of purchasing castings on the competitive system, had finally abandoned buying in the lowest market, and for a number of years had been purchasing only from certain selected suppliers. Quite recently a representative of the American Navy Department had been studying the manufacture of castings in this country and Europe generally because of the very low quality of castings produced in America, and as the result of that visit the American Navy Department had been compelled to adopt the same policy as the British Admiralty. Those were facts which spoke for themselves, and indicated that the system of competitive bids had a distinct effect on the quality of the castings. In the non-ferrous industry, as Mr. Pierce had mentioned, the effect of that system was even more marked, because there were a multitude of minor foundries which were prepared to sell castings at ridiculously low rates. One point which might be impressed upon the plater was that the foundryman was dealing with a very difficult problem all the time, because his was one of the few manufacturing processes which included a change of state or a change of phase. He was dealing with a material which was initially a solid and it was put into the liquid state and then returned to the solid state again. A great deal was heard of the difficulties of machining to fine limits, etc., but the people concerned with that part of the work had the very comforting assurance that they were dealing with a material or metal in one state or phase the whole time, and they did not have the fearful difficulties arising from a change of state or phase due to melting and solidification.

It was comforting to hear from Mr. Caplan that he had purchased bad stampings as well as bad castings, because for many years he had almost been convinced that no such thing as a faulty stamping had ever been made. From the purely metallurgical point of view he would be glad if Mr. Caplan could say if articles that had been plated and bent or mal-formed were subjected to any subsequent heat-treatment, because if the casting was plated and bent it must be metallurgically very unsound indeed, inasmuch as the metal in the plating was of necessity very highly stressed and left in a state of strain which would markedly affect the corrosion resisting properties and heat resisting properties, and also probably its permanence.

Continuing, Mr. Kain said that if the electro-platers would bear in mind what Mr. Pierce had said, they could as a body be of considerable service to the foundrymen on the question of design. Foundrymen were constantly asking for improvements in design which would assist towards sounder castings but, as a general rule, with very little success. If, however, the electro-platers could also bring their influence to bear in that same direction, the founders would be very grateful. It was commonly supposed that if a casting had a uniform section it was usually a sound casting, but that did not necessarily follow. A quantity of information was available showing that because a complicated shape was of uniform section it did not necessarily follow that it was sound. After all, although a casting was plated, the primary condition of the article was the casting, and the plating was a subsidiary operation. Mr. Caplan had stated that it frequently cost more to do the plating than the original casting cost, and if that were so surely the platers should not object to the removal of a reasonable amount of metal in order to ensure obtaining a good service. Finally, Mr. Kain said he could not agree with Mr. Pierce that in making thicker or heavier castings it was desirable to use coarser coal dust. That was a point which was the subject of much discussion in the foundry industry, and one upon which a considerable amount of research was taking place at the present time.

Zinc-Plated Castings

Mr. Velardi mentioned that some months ago a number of zinc-plated castings were sent out to Jamaica, and out of the several hundred of them 13 rusted on one side, the area of the points of corrosion being about the size of a sixpence. When they were sent back and examined it was found that there were blowholes in the castings and that the corrosion had started at those points.

Mr. A. W. Hothersall, referring to the remarks of Mr. Kain concerning foundrymen dealing with a material which underwent a change of state, suggested that the electro-plater is dealing with something far worse even than that, because he was, as it were, passing from the concrete into the spiritual world when depositing metal. To that extent he considered the difficulties of the plater were as great as those of the founder, if not more so. As to the suggestion that the casting itself was the important thing and plating the subsidiary thing, he said that whilst this may be true in some cases there were others in which, where corrosion took place, the plating probably saved the casting to a very considerable extent.

Filled Blowholes

Mr. K. W. Perring, referring to the filling of bad castings with tin, said his experience had been that if the holes were much larger than one-eighth inch diameter it was more or less useless unless the job was done repeatedly, and it was one of the things he would not recommend except in cases where it was impossible to have another casting. Speaking with regard to porosity of castings, Mr. Perring mentioned the case of apparatus to withstand an oil pressure of about one ton to the inch. The actual pump body in this case was made of several castings which were soldered together to make a sound joint, but on testing he got 1 c.c. of water through the casting before there was any sign of oil coming through. As a plater he naturally assumed that the only way the water got in was from the rinsing in the soldering process. If, in fact, that amount of water was absorbed by the castings in this case, there must be a colossal amount of fluids and greases in the average casting which might in many cases explain why it was next to impossible to produce a finish without spoiling the casting.

Mr. Cleaver remarked that it seemed fair to assume from what had been said that if the plater obtained a good casting he could make a good job of the plating, and in this connection there was also everything to be said for the contention of Mr. Pierce that in order to get the right article a suitable price must be paid. The question of patterns was most important, and a little more initial expense upon these would be amply rewarded, especially in the case of repetition work. Another probable reason for bad castings was that the foundryman was not always given all the information necessary when the orders were placed. Probably the founder was not told whether the castings were intended to be plated, and in the absence of that information the castings were probably made the easiest way for the moulder, which was not always the best way in order to obtain a suitable surface for plating.

Dr. S. Wernick (Hon. Secretary, Electro-Depositors' Technical Society) said that from the plater's point of view, wherever blowholes were, it *did* matter, and that, perhaps, was a point which was not sufficiently appreciated by the foundryman. The current impression that a blowhole did not matter in a casting that was to be plated was entirely wrong, because the plating formed a skin across the blowhole leaving exposed spaces underneath which were dangerous in more than one respect. In the first place, there were two different metals in contact, and that was liable to set up electro-chemical action which might have very serious results. Reference had been made by one speaker to zinc-plated articles which might be thought to be entirely corrosion proof, but corrosion spots having an area of about sixpence had manifested themselves, and personally he had no doubt that these were due to plating over blowholes. A second difficulty was the fact that the blowholes formed pockets which took up the plating solution, the cleaning solution, and the other solutions with which unfortunately the castings had to come in contact, and would hold these liquids. Most of the liquids were electrolytes, and unfortunately were very highly corrosive, and when in due course the liquid exuded, the condition known among platers as "spotting out" was difficult to overcome. In fact, in spite of the advance made in electro-deposition in many respects, no real solution for "spotting out" had yet been arrived at. Considerable research was being carried out on this subject, particularly in America where one highly qualified electro-chemist had for some years been trying to get results by certain methods of after-treatment. Nevertheless, there was no definite solution yet, and the problem was a very serious one. Therefore, wherever foundrymen put the blowholes the plater was "up against it."

The comments made by Mr. Pierce seemed to indicate clues as to how existing practice might be altered to get better results from castings. If certain information of an elementary nature applying to both sides of the industry were exchanged, it would surely be of extreme value. The fact, for instance, that various materials were used, such as lime, plumbago, flour, etc., in treating moulds indicated straight away that in cleaning particular castings different treatment must be adopted according to the nature of the casting. A method which would readily and efficiently eradicate lime from a surface would not do at all for plumbago, and the fact that excess of lead was often found in castings was another point which gave the plater some clue as to some of the difficulties he was encountering, because it was very well known that lead was one of the most difficult metals to plate. It might be encountered in part of the surface, and difficulties were almost bound to occur as a result.

Mr. L. Wright, commenting on the reference by a previous speaker to corrosion spots of the size of sixpence, said that this was the effect seen on the outside of the article, but actually the seat of corrosion might only be a pin-hole or blowhole under the plating which was not more than one-eighth inch in area. Speaking of bath taps, he complained that these were too often cast in such a manner that it was impossible adequately to plate them, although it was more than of passing interest to know that when the tap manufacturers began to plate their own taps they quickly altered the design and made it much more simple so that there were no deep recesses and acute angles and corners.

AUTHOR'S REPLY

Mr. Pierce, replying first to Mr. Kain on the question of using a less fine coal dust for castings of thicker section, said he had in mind the question of price, because the finer the coal dust the higher the price. If the particular job would stand the cost of the finer coal dust so much the better. It was very difficult, he continued, to discuss individual cases such as those mentioned of the fittings sent to Jamaica without having the precise details, but on the general question of iron rusting he could assure platers that there were some irons now being manufactured which were very non-corrosive. He had one piece himself which seemed to stand up to atmospheric conditions even better than a plated surface. It had retained its polish for a very long time indeed. It had been quite impossible in a short contribution to deal with the question of patterns, but of course they were a vital feature. Undoubtedly some patterns were simply abominable, and it was quite impossible to get good results in the foundry with them. Where poor patterns were supplied to the founder the customer simply had to take the consequences. Undoubtedly the more perfect the casting in the first place the less was the cost of the finishing operations before plating, because it was not necessary to machine but merely to lap or apply a light grinding operation. Again, the point mentioned by Mr. Cleaver as to giving the founder full information concerning the purpose for which castings were required, was of the utmost importance in securing the most satisfactory results. In the same way Mr. Sydney was perfectly correct when he suggested that a special technique was necessary for castings which were subsequently to be plated, and again the question of the type of workman was important. For instance, a skilled craftsman who might perhaps have worked for a long period in the heavy industry would be found to be useless if he was transferred to light work, and that again demonstrated the importance of a difference in technique. From that point of view it was perhaps essential that foundries should realise this and if necessary leave general engineering work outside their sphere. Certainly some of the plater's troubles were due to the fact that their castings came from foundries which were quite unsuited to produce the class of work required.

Mr. Caplan, after paying a tribute to the quality of the work done by Mr. Pierce's firm,

replied to Mr. Kain's question as to bending a plated article, and said he had never known of that being done with castings. Commenting on what had been said as to the relative value of the original casting and the plating process, he said he included in the cost of plating the various finishing operations and not merely the actual plating. As regards the instances mentioned of the door knocker and the difficulty of plating it in a suitable manner, Mr. Caplan recalled that very often articles extremely difficult to plate were brought to the platers, and his policy was to inform the customer that it was impossible to guarantee the result, although an endeavour would be made to do the work efficiently. On the question of care in watching current consumption, he said that in his own works a loss of even so small a quantity as 10 amperes was invariably traced, because it was obvious that if 10 amperes could be lost a great deal more could also disappear in the same way. The point made by Dr. Wernick concerning plating over blowholes was one of the matters which he himself desired to stress in relation to the necessity for agitating the solution, which went a long way towards avoiding this difficulty.

On the motion of MR. L. P. SYDNEY a cordial vote of thanks was passed to Mr. Caplan and Mr. Pierce. The CHAIRMAN brought the meeting to a close by cordially inviting foundrymen to any meeting of the Electro-Depositors' Technical Society.

Woodworking Machinery Castings

Mr. Ballantine's Paper on "Problems in Woodworking Machinery Castings," which we published in our issue of February 15, 1934, gave rise to a really practical discussion. This was opened by MR. A. BRUCE, who said that they would all agree that they needed first-class patterns and when they received them it took off about 50 per cent. of the trouble in making the castings. He noted that Mr. Ballantine said that many castings were made in green-sand and that the castings varied between 1 cwt. and 5 tons, but he had not stated that the latter was made in green-sand. His firm made castings up to 5 tons in green-sand, but it required very good moulders for green-sand work, and they were dying out. He found that he could get younger men to make the same jobs in dry-sand much quicker simply because they were stronger men. In regard to the soda ash which Mr. Ballantine stated he found so beneficial, he would be glad to know what percentage was used and also the class of iron to get the high polish.

MR. BALLANTINE, replying to Mr. Bruce, said that he probably omitted to mention that the casting in question, which weighed just over 5 tons, and also the bottom pulley, were made in dry-sand. Mr. Bruce's statement that he could get the younger men to make the jobs in dry-sand more speedily than in green-sand did not coincide with his own experience. He maintained that green-sand moulding was speedier because they had no delays; in dry-sand work there was always some delay, which might be one night or two nights, for drying. In the Paisley district they had a very good type of green-sand moulder, but he agreed with Mr. Bruce in stating that such mouiders were dying out. Modern conditions had made them mechanically-minded, and they must train the young men eventually to work machines. In regard to the soda ash, he worked with the lime additions in the ladle before tapping. The percentage used varied according to the class of metal used. He varied the soda ash to suit the silicon, etc., but usually he added about 7 lbs. of limestone and 10 lbs. of soda ash per cwt. of metal, and after eighteen months' experience he could say definitely that he got better surfaces.

MR. J. CURRIE said Mr. Ballantine had mentioned the use of 10 lbs. of soda ash per cwt., but he suggested that figure was wrong. He would like to know where Mr. Ballantine derived the benefit from soda ash. Was it from the reduction of sulphur, the condition of the graphite or the surface of the metal? He had been very interested in the references to camber and would like to ask, in regard to the machine table, was it cast with slots up or down, and could he give any details of the camber of the table with T-slots if cast in green-sand?

MR. BALLANTINE said, in regard to the table with the T-slots, it was not made in green-sand, but the side cheeks were. In regard to the use of soda ash, he had been very observant in the machine shop and found that if the silicon in the metal was 1.6 per cent. the soda ash had a beneficial effect. He only worked by normal reasoning; he was not a metallurgist and could not tell the effect on the graphite definitely, but as an actual fact he found the use of the soda ash very effective.

MR. MARSHALL asked whether, in the case of the screwed roller, Mr. Ballantine used oil-sand cores and, if so, did he use old sand in the mixture. Was the corebox made in wood or metal? Did Mr. Ballantine use oil sand in his aluminium work? In connection with the remarks on cambering and the determination of the allowances necessary under the various conditions mentioned, he would like to know whether Mr. Ballantine had been able to draw up any chart or graph from which the necessary allowances could be established.

MR. BALLANTINE said that the main core for the screwed roller was made in oil sand, as also was the top covering core. The approximate mixture used was 50 per cent. old floor sand, with Spermolin oil, 25 per cent. Belfast red sand and 25 per cent. sharp sand. He also used oil sand in aluminium work. He had not made a chart of the various cambers on a job, but he kept a careful record. Some beds of exactly the same length, but of slightly different design, required quite a different camber allowance.

MR. SIMPSON said he wished to pay tribute to the progressive nature of Mr. Ballantine's methods, but, as the author had himself said, the work was midway between light and heavy foundry work, and that accounted for the very small machining allowances. He thought, however, that that was an unimportant matter, as modern machine tools could as easily remove $\frac{1}{4}$ in. as $\frac{1}{8}$ in. He was interested in the screw roller, but it was by no means new, as he had seen them made in Glasgow more than 30 years ago by the same method, except for the gating.

MR. BALLANTINE, replying to Mr. Simpson, said that machining allowances were a most important point so far as his firm were concerned; there was more trouble on account of heavy or excess metal than anything else. A bearing for a ball race had a $\frac{3}{16}$-in. allowance, and if two cuts were necessary, the casting was scrapped.

The CHAIRMAN (Mr. William Wallace) said that he would speak on behalf of the whole Branch in giving an expression of sincere thanks to Mr. Ballantine for coming to Edinburgh to give them such a profitable and interesting afternoon. He could comment on the machining allowance, but he thought it cut both ways, and on the whole it might be more advantageous to speed up in the machine shop. It had been extraordinarily interesting to see the very fine castings which Mr. Ballantine had exhibited, and he must feel proud to be connected with a line of work showing so much prosperity at the moment.

THE WALLSEND SLIPWAY & ENGINEERING COMPANY, LIMITED, Wallsend-on-Tyne, have received an order from the Commonwealth and Dominion Lines to install the machinery in a new 10,000-ton vessel to be built by Messrs. John Brown & Company, Limited, Clydebank.

A Projected British Foundry School

(*Concluded from page* 199)

The laboratory work will comprise the chemical, microscopic, sands and refractories and mechanical testing laboratories, the experimental foundry and drawing office.

It is unlikely that a course of this character could be arranged for part-time or evening study, for it is equivalent in scope to ten years' normal evening study. The accommodation and equipment required is available in the day time, but not in the evenings, and this is at present an insuperable difficulty. Furthermore, it is considered important that students should be able to come to a course so strenuous as the one outlined with their mental and physical powers entirely free from the preoccupations and responsibilities of everyday work, which makes such demands as to impair capacity in many cases even for limited evening study.

Foreign Schemes of Training

The author has had opportunities from time to time of seeing the schemes of training for foundry work developed in the United States and on the Continent, particularly France and Germany.* Those who are familiar with the schemes of training developed in France and Germany will recognise that the present scheme resembles the French Foundry High School in Paris rather than the German school at Aachen. It is not, however, merely imitative. It has been designed to meet British conditions as the natural outcome of British requirements, based on the foundations which have already been laid.

Summary

The new scheme has this fundamental difference from any other scheme of training. It is intended for men who are already engaged in the industry and who are committed to it as a means of livelihood. It is difficult, if not impossible, to say as the result of a purely academic course whether a man is likely to achieve a responsible position in an industry or not. The man who has already achieved a measure of responsibility has thereby demonstrated not only his practical skill and technical knowledge, but a capacity for leadership which is essential to success. While it may be difficult to arrange for such an executive to leave his post for a period of a year, it is believed that the results will amply justify the effort required.

The author would welcome comments, suggestions and inquiries relating to the scheme.

Catalogue Received

Oil - Film Filters. When we received a catalogue from Messrs. James Keith & Blackman Company, Limited, of 27, Farringdon Avenue, London, E.C.4, we wondered why any one should wish to filter oil films. We quickly learnt, however, that they related to filters for cleaning air. They consist of tray-like units built up into screens or boxes. Each unit weighs about 35 lbs. and is made up of a frame and cell, the latter containing a steel multi-leaf element of special formation, bounded back and front with expanded metal sheets, the whole contained in a neat flanged steel case provided with convenient handles for lifting. There are proper locating arrangements for building up into screens. Inside there are pressed steel of special formation and insterspaced with corrugated steel strips, the main function of which is not only to provide additional filtering surface but also to split up the air films into thin strips and to provide the contact between the filter plates proper and so ensure by capillary action the maintenance of an oil film on both surfaces of each plate.

* See FOUNDRY TRADE JOURNAL, March 6 and 13, April 17 and 24, and May 1, 1930.

Electrochemical Pickling Process

The usual method of pickling with acids has various disadvantages, even when using inhibitors, such as the replenishing of the acid bath from time to time, the cost of treatment of the spent acid to render it harmless, the prevention of dangerous acid fumes, as well as the comparatively long time required in pickling. The pickling time can be much reduced by passing a current through the bath, and if dilute sulphuric acid is used, sulphate ions are then formed at the anode, reacting there with water to form sulphuric acid and oxygen. These two substances possess a high solvent action which accounts for the increased pickling effect when the workpiece forms the anode. The oxygen formed also has a secondary, purely mechanical effect, while the applied potential increases the solution pressure of the anodic metal. In a cathodic circuit, the pickling effect is due to the discharge of hydrogen ions which remove the scale by partly a strong reducing action and partly a purely mechanical action. This latter action is more intense at the cathode than at the anode, as double the amount of gas is evolved. The best effect is produced when the workpiece is used alternately as anode and cathode, but the continual reversal necessary for this offers certain difficulties. Moreover, direct connection to the current supply is only possible with large pieces, and it is not practicable to use small articles, such as screws, directly as electrodes.

To avoid this difficulty and yet make use of the advantages of electrical pickling, an electrochemical pickling process has been evolved in which the work piece is not directly connected to the circuit. In a homogeneous electrolyte between two electrodes, a uniform flow of current passes through the solution over its whole cross-section when a source of current is connected to the electrodes. The density of this current flow varies with the current strength, although it is uniform throughout the bath at any given moment. But as soon as an object with a higher conductivity than the electrolyte is placed between the electrodes, this uniformity is disturbed, as the current always follows the path of least resistance and practically the whole of the current flows through the workpiece. The latter as a result is then divided into opposed electrical halves, the current entering continuously on one side and at the same time continuously leaving on the other. Furthermore, the same amount of current passes through the workpiece when merely immersed in the electrolyte, as when it forms either the anode or cathode, other conditions being equal. The passage of the current also heats the pickling bath in proportion to the current strength, and hence in continuous operations steam-heating can be dispensed with. Reversing the polarity of the workpiece is also simplified in this process, as it has only to be turned round in the bath, while a number of articles can also be treated simultaneously.

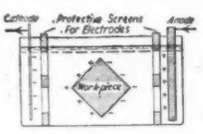


Fig. 1.

The arrangement of the electrochemical pickling bath is shown diagrammatically in Fig. 1, the trough, anode, cathode and electrode screens being made of resistant materials. The shape of the screens depends on the articles treated and should offer the minimum electrical resistance. The pickling of annealed wire rings in 15 per cent. sulphuric acid was completed in 10 min. when using a current density of 30 amps. per sq. m. at 7 volts, the rings being turned once.

Among the various advantages of electrochemical pickling in a neutral salt bath are the elimination of acid and of acid fumes, while the iron scale dissolves and may be recovered as electrolytic iron. Pickling, however, takes longer than usual, but if the process is properly regulated the iron ions entering solution are again deposited at the cathode by the current, and hydrogen formation is a minimum. In practice the following values were found for a pickling bath of this description:—Current density, 200 amps. per sq. m. at 10 volts; total time, 25 min.; work reversed five times; current consumption, 8 kw./hrs. per ton. The temperature of the bath reached 65 deg. C., creating a fairly high vapour pressure, yet no noxious fumes were observed.—"Stahl und Eisen."

Dangerous Tin Position

By "Onlooker"

The state of the tin market to-day may not inaptly be likened to that of an over-venturesome climber, who, having wrung a measure of startled admiration from all onlookers, finds himself in a position from which further progress upward is impossible, while retreat is so compassed with dangers as to be almost out of question. Thus, tin has achieved a price of £236 during a period of considerable trade depression, while its compeers, the other members of the non-ferrous metal group, have struggled to gain a modest increase of a few pounds.

There has been much disagreement in principle ever since the scheme of restricted tin production was launched, and from time to time outspoken comments by prominent people in the trade have given voice to the dissatisfaction felt by large sections of the producers and consumers, but it has been left to the Buffer Pool scheme to arouse a unified storm of protest which will doubtless lead to the idea being abandoned. This idea to retain the remaining balance, amounting to some 8,000 tons, of the Tin Pool and to use it as a means of "balancing" the situation, has inevitably roused a storm of protest, prominent in which is a letter from the London Metal Exchange Committee to the Board of Trade. It may perhaps be said that the tin pool was tolerated because it was felt to be only transient in nature, but the threat to give permanency to this idea of metal held off the market in the shape of this buffer stock, has brought matters to a head.

For the past twelve months and more the tin market has been subject to manipulation, and the situation of necessity very artificial in consequence. Metal Exchange interests, merchants, consumers and producers have perforce submitted to this state of affairs, not willingly, for they have seen clearly enough the dangerous trend of events, but other forces have been too strong for them. Now comes the threat that for an almost indefinite period matters are going to be taken out of their hands, or at any rate that their activities will be circumscribed, because of the fear that, without warning, quantities of the metal may be pushed on to the market. During the past decade there has been quite enough interference with normal trading in the world of metals to last for a long time to come, and it is hardly wonderful that with tin at an unduly inflated price, this new move, which smacks of a financial coup, should be bitterly opposed.

Actually the strength of the tin market at the present time is remarkable, for after a period of stability for many weeks a rise of £10 has been seen, due mainly to the unfortunate decision by the International Tin Committee not to increase quotas as from April 1. Consumption is moderately good and rather on the up-grade, but the statistical position is no longer improving at the rate it was. The end of February saw a further decline in total visible supplies, it is true, to 24,500 tons, or about half the figure twelve months earlier, but with production now on a slightly higher scale, it does not look as if the decline will go very much further, and the U.K. stocks, which now stand at approximately 6,700 tons, will probably be conserved. This absence of change in the statistical position should not in itself matter much, for reserves are now at a fairly reasonable level and not likely to depress values, but the adverse aspect of the tin situation to-day lies in the fact that the inflated price is compelling users to turn to the consideration of substitutes.

Although replacement of tin by other metals is no easy matter, there cannot be any exception to the rule that high prices discourage consumption while an expansion in use takes place when values are low. The past history of tin has proved this up to the hilt, and in these days of modern methods the chances of successful substitution are considerably increased. Small wonder, then, that reports are coming through that aluminium is making inroads on the preserves of tin (literally in the case of the canning of fish!), but in an equally dangerous manner in the brewery trade, where tin pipes are being eliminated by the lighter metal.

This is the beginning of a trend which will persist so long as tin remains above £200 per ton, and, sooner or later, the price must be marked down to a more reasonable level. Were anyone in doubt, all uncertainty is dispelled by the fact that those properties not parties to the pact of curtailed production are putting every ounce of energy into increasing output.

Statistical Method in the Foundry

By collecting as many data as possible concerning the everyday practice of cupolas, Dr. K. Neustätter* has disclosed the effect of several factors upon the operation of the cupola and the properties of the resulting iron. A high atmospheric pressure gives a higher hourly rate of melting and a lower temperature of the molten iron than a low atmospheric pressure. The reverse is the case with a high absolute humidity of the air. Further, a high humidity decreases the carbon, graphite and sulphur content of the iron and increases the hardness, while tensile and transverse strength remain unaltered. In summer the same mixture gives a harder iron than in winter. The temperature of the blast affects the melting rate and the tapping temperature like the humidity. Varying atmospheric pressure acts in the same sense as varying blast pressure.

With increasing volume of blast the melting rate as well as the graphite and silicon content of the iron increase while the tapping temperature decreases. The total carbon content at first increases and slightly drops at very high blast volumes. The reverse is the case with the ferrous oxide content of the slag. The volume of blast does not affect the manganese, phosphorus, and sulphur content of the iron and the manganous oxide content of the slag. With increasing blast pressure the melting rate increases, while the tapping temperature decreases.

Increasing the size of the coke results in a marked increase of the tapping temperature and a slight increase of the melting rate. The rust adhering to the pig and engineering casting scrap exerts a refining action by decreasing the carbon and graphite content of the iron. Tensile and transverse strengths are decreased, the hardness is slightly increased. Provided that it is not present in exceedingly large quantities, the sand adhering to the pig, runners and risers has no detrimental effect upon the quality of the iron. In a case where a low proportion of engineering casting scrap is used in the mixture, varying size of this scrap does not affect the melting conditions. By replacing part of this scrap by domestic runners and risers an increase in hardness, tensile and transverse strength can be obtained. At the same time the sulphur content of the iron is diminished.

* "Die Giesserei," 1934, Nos. 7-8.

East Midland Foundrymen's Annual Dinner

About 70 members and friends had a very enjoyable evening on March 10, 1934, on the occasion of the Annual Dinner of the East Midlands Branch of the Institute of British Foundrymen, held at the Great Central Hotel, Loughborough. Mr. P. A. Russell presided. At the high table were the Mayor of Loughborough (Councillor J. S. Marr), Mr. C. E. Williams (President of the Institute), Mr. S. J. Perry (President, Leicester Society of Engineers), Mr. T. Makemson (General Secretary), Mr. J. Stone (President, Lincoln Section), Mr. V. Delport (American Foundrymen's Association), Mr. S. H. Russell (Past-President of Institute), Mr. A. E. Peace (Vice-President of Branch), Mr. J. F. Driver (Vice-President of Branch), Mr. H. Bunting (Branch-Secretary) and Mr. E. Stevenson, who acted as toastmaster.

A Master Patternmaker on Foundry Progress

The loyal toast having been honoured, MR. S. J. PERRY proposed the toast of "The Institute of British Foundrymen," coupled with the name of its President, Mr. C. E. Williams. Mr. Perry said he had a great admiration for the Institute, and it was to be congratulated on the progress it had made. The results of its work could be seen in the new alloys and in the splendid castings that the engineers were obtaining to-day. He thought the Institute could take a very high position in technical associations of the country. The foundry profession was one that required greater skill from year to year. In many branches of engineering machinery was doing the work and producing the "Robot" machine minder, but the moulder had to use his skill more and more and that should give a feeling of pride in the profession.

Bell Founding

The PRESIDENT (Mr. C. E. Williams) said it was delightful that a patternmaker had a good word for the foundryman. Foundrymen realised that, if anyone was better than the foundryman, it was the patternmaker. He was very pleased to see the Mayor of Loughborough present that evening. He had spent an hour or two in the town and had been very interested in the church bells and carillon. One of the duties of a President was to make a presidential address and he recalled that he had made reference to bells. He had referred to bells worn by Aaron 3,500 years ago, and also of that great bell made by the Russians 200 years ago, weighing 200 tons. Some time ago when visiting Manchester he was interested in the bells of the City Hall, which had been made at Loughborough. Those bells were inscribed, "Ring out the False—Ring in the True." This was the last time he would make an after-dinner speech during his year of office. What was the aim and object of the Institute's dinner, councils, conferences and business activities in general?

The object was not to make foundries or steam engines, etc., but to create happy-hearted human characters. He would suggest the Institute's activities had done much to bring about such a desirable condition. He thought it would be agreed that, far as we were from what we would like it to be, we were far above what was the position 100 years ago. He was proud to be President because he believed, in the Institute, members put away the feeling of envy and brought in the feeling of good-fellowship, and that feeling was extended to all foundries in all countries. He would like to congratulate the Branch on its President, Mr. P. A. Russell, who does such good work, and also on its secretary, Mr. Bunting. Mr. Bunting was the doyen of all Branch Secretaries and must be approaching his majority as a secretary. Thanks were due to the Branch for its economies. Referring to the new rules, Mr. Williams said he was sure all would join him in expressing his appreciation and thanks to the committee for carrying out that tedious work.

East Midland Activities

MR. T. MAKEMSON, submitting "The East Midlands Branch," said that in visiting various Branch dinners it was frequently his lot to propose "The Branch." He was not weary of that because, in the Institute, it was the Branches that were the important units. The Institute, through its Branches, was doing work of a national importance, and this Branch was taking its share in that work. All were aware of the certificate scheme and the part taken by Mr. S. H. Russell, and he believed there were three members of the Branch in the room who were awarded certificates. Some might know that other educational schemes were being arranged, one at Sheffield University and the other at Birmingham. These schemes had their origin in the proposals of a Past-President of the Branch, Mr. T. Spiers, and a Paper read before the Branch by Mr. V. C. Faulkner. They had been suffering from bad trade conditions, but the Branch had successfully carried on very economically, under the leadership of its many able Presidents and its secretary, Mr. Bunting. He must mention some of its members on the technical committees. Two members of the Branch were convenors of sections, Mr. Russell and Mr. Peace. The Cast Iron Committee under Mr. P. A. Russell were investigating certain phenomena and tabulating in a way to make useful to the general foundrymen. He wanted it to be understood that much of the success was due to the work of Mr. P. A. Russell. Mr. Russell was carrying on a family tradition and following in the footsteps of his brother as President of this Branch.

Value of Co-operation

MR. P. A. RUSSELL, responding, said he must first thank Mr. Makemson for the nice things he had said. Without patting oneself on the back, he did think the East Midlands Branch carried its weight, and was glad to hear Mr. Makemson's confirmation. He was pleased Mr. Makemson had referred to other members. He felt he owed an apology to the Branch. He had intended to relinquish his chairmanship of the Technical Committee during his year of office, but had been halfway through the work referred to, and if the Branch had in any way suffered due to that work, he was sorry. He wished to apologise to the Lincoln Section, as he had intended to pay them a visit, but he could not get away on any Saturday when their meetings were arranged. One of the Institute's functions was improving the outlook of its members. The foundryman who was not a member did not get the other aspects and became self-centred. He was sorry he had to apologise for the absence of the Lord Mayor of Leicester (Ald. Billings), Mr. Schofield (Principal of Loughborough College) and Mr. Kershaw (Principal of Leicester Technical College). In conclusion, he wished to express his thanks for the support of the members, the Council, and the secretary. For years past he had heard his predecessors in the chair saying that the presidency was 100 per cent. honour, and that all the work was done by Mr. Bunting, and he had put that down to their modesty, but he had found out what a very efficient secretary they had, and he must express his appreciation of Mr. Bunting, who was completing his 19th year as Branch-Secretary.

"Our Guests" was ably proposed by Mr. A. E. Peace (Vice-President of the Branch), and was replied to by the Mayor of Loughborough and Mr. V. Delport, who extended an invitation for members to join the party to tour the U.S.A. on the occasion of the forthcoming International Conference at Philadelphia.

Musical items given by the Bric-à-Brac Concert Party were thoroughly enjoyed.

Hardness Tests

SIZE OF SPECIMENS

At a meeting of the Institute of Metals, held in London recently, DR. G. A. HANKINS and MR. C. W. ALDOUS presented a Paper on "Minimum Dimensions of Test Samples for Brinell and Diamond-Pyramid Hardness Tests." We append the authors' synopsis.

The investigation was carried out to determine the effect of variations in the dimensions of test samples on the results of Brinell and diamond-pyramid hardness tests, and to suggest minimum dimensions of test samples. The work, which is of particular importance with regard to Brinell tests on bars and thin plates, and with regard to both Brinell and diamond-pyramid hardness tests on metal sheet and strip materials, comprises an experimental examination of (*a*) effect of width of specimen on Brinell-hardness test results; (*b*) effect of thickness of specimen on Brinell-hardness test results; (*c*) effect of thickness of specimen on diamond-pyramid hardness-test results. The metals investigated include copper, brass, aluminium and steel.

It is concluded that a width of test-specimen of $4\frac{1}{2}$ times the diameter of the impression is satisfactory for accurate Brinell tests on all the materials examined. In regard to the thickness of samples for Brinell tests, the limiting value of the ratio of thickness of test sample to depth of impression for accurate results appears to be a characteristic of the test material; a value of the ratio of 6 is required for mild steel, about 15 for copper, and more than 20 for spring steel. In carrying out diamond-pyramid hardness tests on thin samples, a limiting value of the ratio of test-sample thickness to impression diagonal of $1\frac{1}{2}$ gives results which are practically independent of test-sample thickness for the majority of sheet metals, with the exception of soft copper and soft brass.

Dorman, Long & Company, Limited

EXTENSION OF MORATORIUM

Meetings of the holders of the 4 per cent. first mortgage perpetual debenture stock and the $5\frac{1}{2}$ per cent. first mortgage redeemable debenture stock of Messrs. Dorman, Long & Company, Limited, were held on March 9 to consider a scheme providing for the extension of the existing arrangements until July 31, 1934. Mr. Charles Mitchell presided at both meetings, and a card vote was taken. It was announced later that the resolutions were carried by the requisite majorities.

At the meeting of the $5\frac{1}{2}$ per cent. debenture holders, Sir Miles Mattinson (chairman of the holders' committee) said that it was clear from a valuation of the company's property as a going concern that a large proportion of the share capital of the company was not represented by assets, and the reduction of the share capital, which had already been agreed in principle with the shareholders, was not more than sufficient to meet the requirements of the case. Although the better trading and the drastic economies were valorising their assets and creating a better foundation for a better plan than seemed possible a short time ago, it seemed that the pressure of fixed charges would have to be eased to a considerable extent in the near future. Unless there was extreme goodwill on the part of everyone concerned, it was very doubtful whether any scheme could be brought to fruition by July 31. It was possible that if the economies now being made were as great as he believed they would be, and also if the general trade of the country should grow, they might be in a position at the end of the year to consider a more favourable plan than was possible at the present.

At the meeting of the 4 per cent. debenture holders, held earlier, the chairman said that the extension in no way prejudiced their interests. What they were being asked to concede was, until July 31, to bind themselves to refrain from embarrassing action while the negotiations for the preparation of a scheme were in progress.

This Week's News in Brief

Trade Talk

The Canadian Pacific liner, "Metagama" (12,420 tons), has been sold to British shipbreakers for about £18,250.

No. 1 Bessemer blast furnace at the Cleveland works, Middlesbrough, of Messrs. Dorman, Long & Company, Limited, has recently averaged over 2,800 tons per week.

Substantial orders for steel plates and sheets, tubes, tinplates and special steels have been placed with United Kingdom firms by Arcos, Limited, on behalf of the Soviet Government.

Messrs. Dorman, Long & Company, Limited, have applied to Middlesbrough Corporation for a supply of gas to their Middlesbrough works, to be used for the smelting of non-ferrous metals.

The Belfast Water Board has placed an order with the South Durham Steel & Iron Company, Limited, which will be executed at their Malleable Works, Stockton, for 5 miles of piping, the total weight of which will be about 1,200 tons.

The Electricity Committee of Glasgow Corporation report that the sale of current used by industrial concerns showed an increase of 10 per cent. for the period June 1, 1933, until the end of February, 1934. The increase is attributed to an improvement in trade generally, and the committee are hopeful that the increased demand will be maintained throughout the rest of the departmental year.

At a special meeting of the West of Scotland Engineering and Shipbuilding Trades Committee, held on March 15, it was agreed to ban all overtime in the shipyards from April 9. The district committees of the shipyard unions will immediately open a campaign against all overtime. The unions contend that between 60 and 70 per cent. of the shipyard trades in the Clyde area are unemployed and a good number of those in employment asked to work overtime.

Five vessels have arrived and discharged cargoes of iron ore at Rothesay Dock during the past week. The total tonnage from the five vessels is over 22,000 tons, which in present times is an exceptionally large importation over a short period. To a certain extent it might be regarded as an accidental concentration of arrivals, but it is at least a continuation of the steady improvement in ore imports which has been evident for some time past, and which has reflected the better prospects in the Lanarkshire iron and steel industry. Further large cargoes are expected to arrive in the near future.

Sir Alfred Herbert, who was the principal guest at the annual dinner in Glasgow on March 10 of the West of Scotland Association of Foreman Engineers and Draughtsmen, said that during his two days' stay in the city he had visited four or five prominent engineering establishments, and in one of the most interesting of these, which was devoted to the making of auxiliary machinery for the Navy and the mercantile marine, he had been amazed to see the technical advances which had been made. The works were not only busy, but a managing director told him that the outlook for two years was definitely good. In his own business, the making of machine tools, they were conscious of a marked improvement in the situation and in the general demand.

Negotiations which have been proceeding for several months on an important inquiry received from the Soviet Government for a large contract for steel tubes of all descriptions, totalling upwards of £1,000,000 in value, were brought to a successful conclusion last week. The group of British firms who will participate in the order comprises Messrs. Stewarts and Lloyds, Limited, Tube Investments, Limited, and British Mannesmann Tube Company, Limited, who between them control approximately 90 per cent. of the tube trade of Great Britain. It is probably true to state that the successful outcome of these negotiations may be largely attributable to the trade agreement recently made between the U.S.S.R. and Great Britain. This contract will mean increased employment in the West of Scotland, the Midlands and South Wales.

In the course of a lecture on "Foundry Costs" to the Glasgow district of the Institute of Cost and Works Accountants in Glasgow this week, Mr. A. F. Patterson, of Messrs. Babcock & Wilcox, Limited, Renfrew, stated that accurate cost information was undeniably the only true basis upon which to make prices, and that the foundryman's most dangerous competitor and the industry's greatest menace was the man who did not know what his different kinds of castings cost him to produce. Most errors in foundry-costs finding came from using methods which did not truly reflect the amount of work, material and use of equipment properly chargeable to different types of castings. It was not enough to charge all the expenses of the business to the product and get it back in selling price. Correct costing demanded that each type of casting carried only that part of the expenses it involved.

Company Reports

Vickers, Limited.—Dividend for year of 4 per cent., less tax, on ordinary shares.

General Refractories, Limited.—Final dividend of 8 per cent., making 10 per cent. for 1933.

Radiation, Limited.—Final dividend on the ordinary shares of £9 7s. 6d. per cent., making 12½ per cent. for the year 1933.

Hoffmann Manufacturing Company, Limited.—Net trading profit, £89,863; brought in, £50,529; ordinary dividend of 7½ per cent.; carried forward, £49,926.

British Insulated Cables, Limited.—Profit for 1933, £517,000; to reserves and depreciation account, £160,000; final dividend of 10 per cent., making 15 per cent.; carried forward, £300,000.

Bairds & Dalmellington, Limited.—Net profit, after providing for depreciation, debenture interest, income tax and contingencies, £61,540; brought in, £11,007; dividend of 3 per cent. on the ordinary shares, £48,569; carried forward, £23,977.

British Aluminium Company, Limited.—Profit for 1933, including the amount brought forward, after making provision for taxation and debenture interest and after placing £50,000 to depreciation reserve, £162,830; dividend of 5 per cent. on the ordinary shares; carried forward, £52,778.

Vickers-Armstrongs, Limited.—Net trading profit, £491,952; income tax, directors' fees and depreciation, £303,539; dividend at the rate of 7 per cent. per annum, less tax, on the "A" preference share capital for seven months ended November 30, 1930, £186,307; brought in, £76,389; carried forward, £77,995.

International Nickel Company of Canada, Limited.—Total income, U.S. $16,796,828; expenses, $2,576,840; interest charges, $449,763; depreciation, etc., $4,107,641; net profit, $9,662,584; brought in, $14,688,560; tax adjustments, $350,325; available, $24,701,469; preferred dividends, $1,933,899; carried forward, $22,767,570. No dividends were declared on the common stock, but the directors are resuming payments on that stock on March 31 next with a dividend of 10 cents a share.

Contracts Open

Doncaster, March 26.—Supply and laying of 1¼ miles of 18-in. dia. cast-iron or steel pipes (contract No. 19), for the Town Council. Mr. F. Oscar Kirby, water engineer, 2, Priory Place, Doncaster.

Edinburgh, March 24.—858 hob mantel register grates (with flues and boilers), and 942 mantel register grates, for the Town Council. Mr. E. J. MacRae, city architect, City Chambers, Edinburgh, 1.

Chelmsford, April 9. — Pumping machinery, including electric motors, for the Joint Sewerage Committee. Messrs. Silcock & Simpson, 25, Victoria Street, Westminster, S.W.1, and 10, Park Row, Leeds, 1. (Fee £5, returnable.)

New Companies

Chesterfield Fireclays Company, Limited.—Capital £3,000. Directors: T. Pearson, Red House, Stonegravels, Chesterfield; F. S. Short.

C. G. Morton, Limited.—Capital £1,000. Steel and iron manufacturers and merchants, etc. Directors: C. G. Morton, 50, Greystones Avenue, Sheffield; R. Morton.

Catherall's Steel Company, Limited.—Capital £5,000. Steel manufacturers. Directors: A. C. Catherall, Beth Sheila, Bawtry Road, Rotherham; E. A. Eastwood.

Personal

Mr. F. W. Marshall, head of the buying department of the Consett Iron Company, Limited, has retired after 39 years' service.

The board of directors of the Union Bank of Scotland have elected Mr. Maurice E. Denny, C.B.E., B.Sc., J.P., chairman of Messrs. William Denny & Bros., Limited, Leven Shipyard, Dumbarton, to be an ordinary director of the bank. Mr. Denny is son and heir of Sir Archibald Denny, Bt., and has had a distinguished career; in addition to being chairman of the famous shipbuilding and engineering firm, he is a director of three shipping companies and a public-utility company in England. He is a Vice-President of the Shipbuilding Employers' Federation and a Past-Master of the Worshipful Company of Shipwrights, and a member of Council of the Institution of Naval Architects. Mr. Maurice Denny received his early training in Messrs. Denny & Bros.' establishment in Dumbarton, where he served his apprenticeship. He later served in the drawing office of Messrs. William Doxford & Sons, Limited, Sunderland. In 1910 he returned to Dumbarton, and in 1911 was made a partner in the firms of Messrs. Denny & Bros., Limited, and of Messrs. Denny & Company, Limited. He became vice-chairman of Messrs. Denny Bros. in 1919 and chairman in 1922.

Wills

Rogers, Thomas, of Ellesmere, Salop, ironfounder	£46,109
Finlay, Alexander, of Messrs. Finlay & Hodgson, iron and steel merchants, London	£2,694
Watson, Lieut.-Col. John, of Sheffield, chairman of Messrs. Watson, Saville & Company, Limited, steel manufacturers	£3,584

Obituary

Mr. David Crawford, who had been for many years in the service of Messrs. Babcock & Wilcox, Limited, Renfrew, died at his residence in Highburgh Road, Hyndland, Glasgow, on March 13. Mr. Crawford had been chief of the purchasing department for a long time.

The death occurred, at his home in Dumbarton on March 14, of Mr. John Campbell McPherson, managing director of Dennystown Brass Works, Limited, Dalreoch. Mr. McPherson was in his 78th year, and in his day was a famous footballer, being capped for Scotland on eight occasions between 1879 and 1885.

We regret to record the death of Captain Malcolm Alfred Kennard, R.N., chairman of the Falkirk Iron Company, Limited, which occurred at his residence in Bampton, North Devon, on March 12. Captain Kennard entered the Navy in 1890, and retired in 1912. He returned to the Service in 1914, and served throughout the war. He was the son of Mr. Edward Kennard, who was for many years a director of the Falkirk Iron Company, and grandson of Robert William Kennard, who acquired the Falkirk Iron Works in 1849. Captain Kennard had been chairman of the company for five years, and he was also a director of Allied Ironfounders, Limited, and had taken a very active part in the administration of the affairs of the combine from its inception.

We very sincerely regret to announce the death of Dr. Walter Rosenhain, F.R.S., at the age of 58. He was a well-known personality in the foundry industry, and his last Paper was given at the Newcastle Conference some two years ago. He was the most accomplished speaker in the metallurgical world. Socially, he was rather shy and retiring, but those of us who knew him best realised that this masked a kindly heart and happy disposition. He was always ready to give the benefit of his profound knowledge to the younger generation. He was an ardent supporter of the technical Press, being appreciative of its value for popularising scientific research and discovery, and sympathetic towards the difficulties of its work. He always took more than a passing interest in our column "Random Shots," as this was originated by his eldest daughter, the late Mrs. J. G. Pearce, M.A. He leaves a widow and two daughters, and to them and to Mr. Pearce we offer the sincere condolences of the whole of the foundry industry.

XUM

Raw Material Markets

Increased activity has been seen in the iron and steel markets, consumers being more willing to enter into contracts for forward supplies. The home demand for pig-iron is still expanding, and the output has been further increased.

Pig-Iron

MIDDLESBROUGH.—Heavy buying of Cleveland foundry iron by local and Scottish users has been recorded, and it is evident that conditions in the consuming industries are improving. The current output is fully absorbed, unsold stocks are very low, and the makers in some cases are almost fully sold for some months ahead. In these circumstances, little export business is being done. Home sales are regulated by the agreed scale of zone prices, which, in the case of the standard No. 3 Cleveland G.M.B. quality, are 67s. 6d. per ton delivered in the Middlesbrough area, 69s. 6d. delivered North-East Coast, 67s. 3d. delivered Falkirk and 70s. 3d. delivered Glasgow. The usual differences for other grades, viz., 2s. 6d. extra for No. 1 foundry and 1s. discount for No. 4 foundry and No. 4 forge iron, are maintained.

There continues to be a heavy demand for East Coast hematite, and the producers are confident that they will be able to dispose of the output of the additional furnaces which have just been put into blast (there are now nine stacks in operation on this grade of iron). The announcement of the new minimum prices, which generally represented a slight reduction on the old quotations, has been followed by increased buying. The fixed price of East-Coast hematite No. 1 grade delivered in the Tees-side area is 68s., which is equivalent to 67s. 6d. for mixed numbers. No. 1 quality delivered to other areas is quoted as follows:—Durham and Northumberland, 70s.; Yorkshire, 74s. to 77s.; Scotland, 75s.; Cumberland, Westmorland and Furness district, 76s. per ton.

LANCASHIRE.—As was indicated last week, the Midland ironmasters are now applying the same price basis to practically all points in Lancashire. This means that many users in this area have to pay an increase of from 1s. to 2s. per ton. Manchester, Warrington, Oldham and Ashton-under-Lyne, as well as Stockport, Stalybridge and Glossop, which are outside the county area, all have to pay 2s. more, and Wigan, Bolton, Barrow, Rochdale and Castleton 1s. more, thus bringing these two former separate zones to the level of the highest zone, the new basis price being 74s. The only exception is Widnes, whose rate is 72s. 6d., the explanation, apparently, being that Indian brands are being carried by water from Liverpool to that centre at a low cost. Cleveland iron automatically came into line with Midland brands. The zone price for Derbyshire, Staffordshire and North-East Coast foundry iron, delivered Lancashire, is 74s., with Northants at 72s. 6d. and Derbyshire forge iron at 69s. to approved consumers and at a minimum of 70s. to foundries. Scottish iron is maintained at about 85s., delivered Manchester or equal, but is handicapped by offers of cheaper Indian brands.

MIDLANDS.—The ironfounding industry in this area is in a decidedly better position than it was twelve months ago. A number of the foundries have well-filled order-books, and orders for spring supplies of iron are coming through. Quotations remain at 67s. 6d. for Northants and 71s. for Derbyshire, Staffordshire and Lincolnshire No. 3, delivered Birmingham and Black Country stations, with an extra of 7d. for delivery into works. Scottish No. 3 iron is offered at 87s. 6d. delivered here, and prices for other low-phosphorus irons are from 82s. 6d. to 90s. per ton. Refined pig-iron for special work is offered at from £5 15s. to £6 15s. delivered local points.

SCOTLAND.—Buying of Scottish foundry iron has not been so active, prices being maintained at 70s. f.o.t. furnaces for No. 3, with an extra of 2s. 6d. per ton for No. 1. Many light-castings makers have recently contracted for supplies and are therefore off the market. Cleveland prices are unchanged at 67s. 3d. f.o.t. Falkirk and 70s. 3d. f.o.t. Glasgow.

Coke

Somewhat quieter conditions prevail in the foundry-coke market, many consumers being covered. Present quotations for delivery in the Birmingham area are as follow:—Best Durham coke, 36s. 6d. to 40s.; Welsh coke, 36s. to 45s.; Scottish, 40s. to 41s. per ton.

Steel

In the semi-finished steel department there is less pressure upon the producers than in the early part of the year, but good quantities of material are passing into consumption. Most consumers are well covered, and specifications are reaching the works on a satisfactory scale. Continental competition is negligible, as the prices asked are practically the same as those for British material. The market for finished steel materials is strong in nearly all departments. Export business is quiet, but there has been a fair amount of buying in the home market for stock replenishment, and the steelworks generally are well occupied.

Scrap

Heavy-metal prices in the Cleveland area have been rather unsteady lately. Ordinary quality is now at about 50s. and machinery metal at about 53s. Light metal is at 46s. per ton. In the Midlands, foundrymen offer 55s. for heavy machinery metal in cupola sizes, 50s. for good heavy metal and 47s. 6d. for clean light scrap, all delivered works. There is only a limited market in South Wales. In Scotland, heavy machinery metal is still at about 58s. 6d. and ordinary cast iron at 55s.

Metals

Copper.—Business in copper has been rather slack lately, trade users having shown little willingness to buy, and prices have in consequence weakened slightly. The London market continues to be affected, to a certain extent, by developments in the United States, where the revised "Copper Code" is now receiving the attention of the Government. Better conditions are reported at the American brass-manufacturing works. Increased activity is also stated to prevail at the working-up plants in Germany.

The week's prices have been as follow:—

Cash.—Thursday, £32 5s. to £32 6s. 3d.; Friday, £32 10s. to £32 11s. 3d.; Monday, £31 13s. 9d. to £31 15s.; Tuesday, £32 2s. 6d. to £32 3s. 9d.; Wednesday, £32 3s. 9d. to £32 5s.

Three Months.—Thursday, £32 8s. 9d. to £32 10s.; Friday, £32 13s. 9d. to £32 15s.; Monday, £31 18s. 9d. to £32; Tuesday, £32 6s. 3d. to £32 7s. 6d.; Wednesday, £32 8s. 9d. to £32 10s.

Tin.—Following the sudden rise in the price of this metal a week ago, there has been a certain amount of profit-taking by speculators, and quotations have therefore receded slightly, but are still firm and above the levels that prevailed until recently.

"The earlier firmness was to some extent influenced by the activity prevailing in America, where a large business was reported and the improved outlook for this metal—fostered by the belief that the seasonal development of trade would continue in the next months and that the statistical position would in consequence show further improvement—stimulated an active general demand for all positions. Later, however, with quieter conditions obtaining in America and the higher prices on this side attracting some persistent selling and liquidation, values receded and the market developed considerable irregularity." report Messrs. Rudolf Wolff.

Daily quotations:—

Cash.—Thursday, £234 7s. 6d. to £234 12s. 6d.; Friday, £234 5s. to £234 7s. 6d.; Monday, £232 15s. to £233; Tuesday, £234 7s. 6d. to £234 10s.; Wednesday, £234 15s. to £235.

Three Months.—Thursday, £233 to £233 5s.; Friday, £233 5s. to £233 7s. 6d.; Monday, £231 12s. 6d. to £231 15s.; Tuesday, £232 15s. to £232 17s. 6d.; Wednesday, £233 5s. to £233 10s.

Spelter.—There is a fair demand from consumers for this metal, but, good supplies being available, the market maintains its equilibrium. The demand for galvanised sheets is poor, and there are still many mills in this country either idle or on short time.

Price fluctuations:—

Ordinary. — Thursday, £14 15s.; Friday, £14 12s. 6d.; Monday, £14 11s. 3d.; Tuesday, £14 12s. 6d.; Wednesday, £14 13s. 9d.

Lead.—Dealings have been on a very limited scale and the market seems to have relapsed into a lethargic condition. In some branches of the building industry there is a brighter outlook, but this has not been sufficient to affect the price of the raw material. It is generally realised that the price of lead is very low, but at the same time it is too early to expect any marked advance with business on its present scale state Messrs. Brandeis, Goldschmidt in their weekly report.

Daily market prices:—

Soft Foreign (Prompt).—Thursday, £11 11s. 3d.; Friday, £11 12s. 6d.; Monday, £11 8s. 9d.; Tuesday, £11 7s. 6d.; Wednesday, £11 7s. 6d.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

27,956. GENERAL ELECTRIC COMPANY, LIMITED. Process for coating articles with molybdenum. 402,916.

7,090. ROYEN, DR. H. J. VAN. Hot shaping of steel. 402,972.

8,619. STEWARTS AND LLOYDS, LIMITED, and MCLAY, G. S. Manufacture of hot billets and the like. 402,979.

15,943. UNITED STEEL COMPANIES, LIMITED, NORBURN, J. C., and COY, E. R. Profile-forming attachments for lathes 403,021.

16,857. SHEVLIN, J. T. (Siemens-Schuckertwerke Akt.-Ges.). Extrusion presses for use in the manufacture of lead pipes. 403,108.

21,778. VEREINIGTE STAHLWERKE AKT.-GES. Process of, and apparatus for, bright-annealing metals. 403,170.

10,133. SCHEMMANN, W., and KOTTMANN, F. Scaling and fettling machines. 403,263.

11,547. KRUPP AKT.-GES. FRIEDRICH-ALFRED HÜTTE, F. Manufacture of sheet-metal piles. 403,276.

15,981. BUDD MANUFACTURING COMPANY, E. G. Welding. 403,301.

19,157. VEREINIGTE STAHLWERKE AKT.-GES. Tuyere for shaft furnaces. 403,321.

23,477. BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Fusion welding. 403,342.

16,262. BURNAND, W. E. Apparatus for the electric heat-treatment of metals. 403,404.

26,347. FIELDEN, F. Cast-metal road surfaces. 403,485.

33,529. RODE, F. J. Sheet-metal drawing presses. 403,516.

33,530. RODE, F. J. Sheet-metal drawing presses. 403,517.

11,709. DEMAG AKT.-GES. Machines for straightening metal and like bars. 403,558.

14,451. CLOUSE, W. L Method of and means for producing blanks for roll-threaded bolts and the like. 403,566.

21,398. HUDSON, W. S., and HUDSON, E. Rims of metal-plate walling, such as that of wagon bodies, tanks and the like. 403,594.

8,864. REPUBLIC STEEL CORPORATION. Process of and an apparatus for making pipe, and the pipe produced thereby. 403,684.

18,293. AKT.-GES FÜR TIEFBOHRTECHNIK UND MASCHINENBAU VORM. TRAUZL & COMPANY. Universal burner cutting and welding machine. 403,695.

Date Marking on M. & C. Conveyor Belting

The importance of knowing exactly to a month the age of conveyor belts will at once be appreciated, and to this end Mavor & Coulson, Limited, have arranged that, in future, belts supplied with M. & C. flat or troughed belt structures will be marked in such a manner as to enable this information to be obtained at a glance, no matter how long after purchase.

XUM

PULVERISED FUEL FIRING PAYS

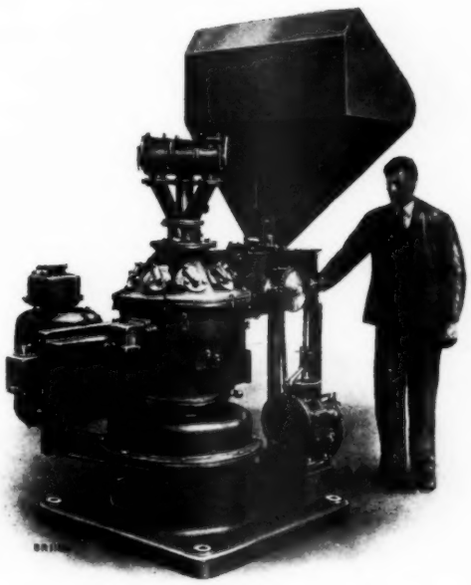
PROVED BY THE REMARKABLE RESULTS INVARIABLY OBTAINED WITH

BRITISH REMA

UNIT PULVERISING SYSTEM

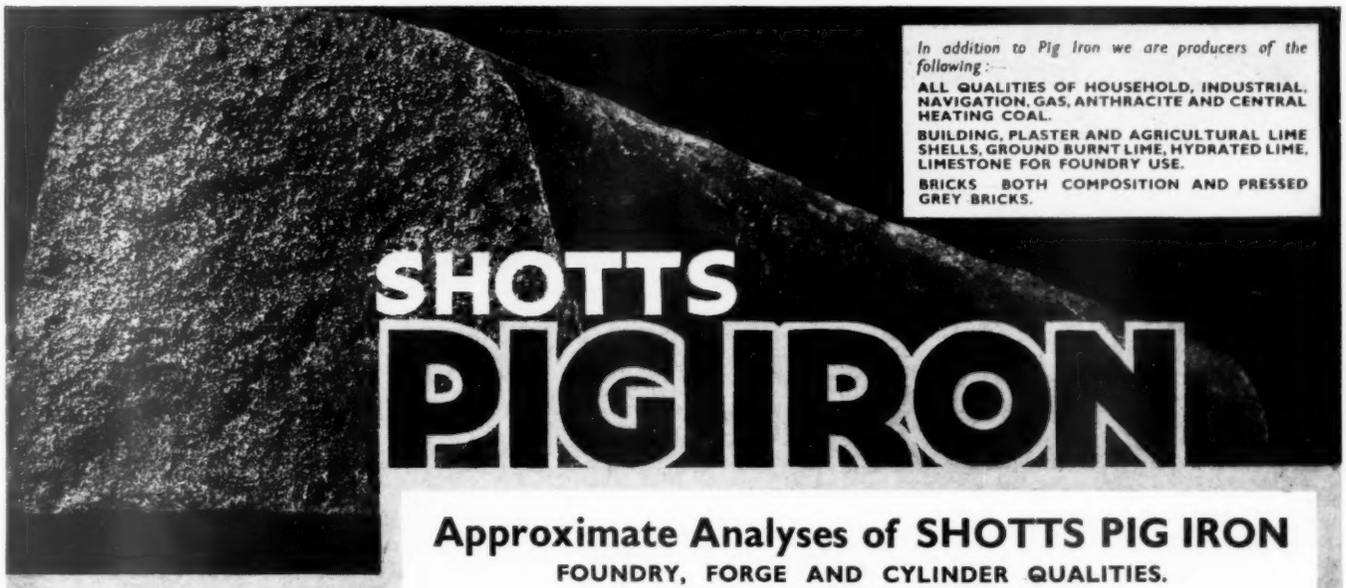
PERFORMANCE ON A BATCH OF MALLEABLE IRON ANNEALING OVENS:—

- Coal consumption reduced by 35%.
- Firing time reduced by 10%.
- Slack used instead of best lump coal.
- Ovens up to full heat in 14 hours.
- A saving of £785 per annum with a capital expenditure of £550.
- Even temperature.
- Easily understood by ordinary firemen.
- Automatic in operation and requires practically no attention.



British Rema No. 2 Patented Firing Unit fitted with Patented Three-way Distributor and bye-pass valve for firing one, two or three Malleable Iron Annealing Ovens.

THE BRITISH REMA MANUFACTURING CO., LTD.,
Hubert Street Works, HALIFAX.



In addition to Pig Iron we are producers of the following:—

ALL QUALITIES OF HOUSEHOLD, INDUSTRIAL, NAVIGATION, GAS, ANTHRACITE AND CENTRAL HEATING COAL.

BUILDING, PLASTER AND AGRICULTURAL LIME SHELLS, GROUND BURNT LIME, HYDRATED LIME, LIMESTONE FOR FOUNDRY USE.

BRICKS BOTH COMPOSITION AND PRESSED GREY BRICKS.

SHOTTS PIG IRON

Approximate Analyses of SHOTTS PIG IRON

FOUNDRY, FORGE AND CYLINDER QUALITIES.

All from Coal fired Slow Smelting Furnaces.

	No. 1 %	No. 3 Soft %	No. 3 Medium %	No. 3 Hard %	No. 4 Soft %	No. 4 Hard %	Cyl. Iron %	Motor Cyl. %	No. 3 Low Phos. %	No. 4 Low Phos. %
Silicon ...	3.25	2.75	2.30	2.10	1.70	1.35	1.50	2.20	2.75	1.50
Sulphur ...	.02	.03	.04	.05	.06	.08	.09	.07	.04	.08
Phos. ...	.50	.50	.50	.50	.50	.40	.40	.32	.20	.20
Mang. ...	1.20	1.15	1.10	1.00	.95	.85	.85	1.08	.80	.80
Graphitic Carbon	3.55	3.40	3.30	3.15	3.10	2.85	2.65	2.80	3.30	2.85
Combined Carbon	.25	.30	.37	.45	.45	.63	.67	.60	.45	.65

Compositions other than the above regularly made to Customer's requirements.

The
SHOTTS IRON Co. Ld.
1 CASTLE ST., EDINBURGH.
Telephone:- 25232 EDINBURGH.
Telegrams:- SHOTTS EDINBURGH.
BRANCH OFFICE—
141 WEST GEORGE STREET, GLASGOW.
Telephone:-GLASGOW CENTRAL 1455
Telegrams:- SHOTTS IRON GLASGOW

RAW MATERIALS—PRICE LIST

(Wednesday, March 21, 1934)

COPPER

	£	s.	d.
Standard cash	32	3	9
Three months	32	8	9
Electrolytic	35	5	0
Tough	34	0	0
Best selected	34	10	0
Sheets	62	0	0
India	43	15	0
Wire bars	35	10	0
Ingot bars	35	5	0
H.C. wire rods	37	10	0
Off. av. cash, February	33	2	1¼
Do., 3 mths., February	33	5	6
Do., Sttlmnt., February	33	1	9
Do., Electro, February	36	4	8½
Do., B.S., February	36	3	1½
Do., wire bars, February	36	10	0
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			6½d.

BRASS

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8¾d.
Rods, extd. or rlld.	4½d.
Sheets to 10 w.g.	7½d.
Wire	7¾d.
Rolled metal	7d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¾d.

TIN

	£	s.	d.
Standard cash	234	15	0
Three months	233	5	0
English	235	10	0
Bars	237	0	0
Straits	238	5	0
Australian (nom.)	—		
Eastern	234	5	0
Banca	238	10	0
Off. av. cash, February	226	16	2½
Do., 3 mths., February	226	8	2½
Do., Sttlmt., February	226	16	3

SPELTER

	£	s.	d.
Ordinary	14	13	9
Remelted	15	0	0
Hard	12	10	0
Electro 99.9	17	0	0
English	15	2	6
India	14	5	0
Zinc dust	20	0	0
Zinc ashes	3	5	0
Off. aver., February	14	19	8½
Aver. spot, February	14	16	10½

LEAD

	£	s.	d.
Soft foreign ppt.	11	7	6
Empire	11	13	9
English	12	15	0
Off. average, February	11	15	5⅝
Average spot, February	11	12	8¼

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex whse.	23	0	0
Rods	29	0	0

ANTIMONY

	£	s.	d.	£	s.	d.
English	39	0	0	to 40	0	0
Chinese, ex-whse.				31	0	0
Crude				20	0	0

QUICKSILVER

	£	s.	d.	£	s.	d.
Quicksilver	10	7	6	to 10	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS

	£	s.	d.
Ferro-silicon—			
25%	8	17	6
45/50%	13	0	0
75%	18	2	6
Ferro-vanadium—			
35 50%	12/8 lb. Va.		
Ferro-molybdenum—			
70/75% carbon-free of Mo.	5/6 per lb.		
Ferro-titanium—			
23/25% carbon-free	9d. lb.		
Ferro-phosphorus, 20/25%	£14	10	0
Ferro-tungsten—			
80/85%	2/7 lb.		
Tungsten metal powder—			
98/99%	2/10 lb.		
Ferro-chrome—			
2/4% car.	32	0	0
4/6% car.	23	0	0
6/8% car.	21	12	6
8/10% car.	21	12	6
Ferro-chrome—			
Max. 2% car.	37	10	0
Max. 1% car.	38	15	0
Max. 0.70% car.	42	0	0
70% carbon-free	10½d. lb.		
Nickel—99.5/100%	£225 to £230		
"F" nickel shot	£202	10	0
Ferro-cobalt, 98/99%	5/3 lb.		
Metallic chromium—			
96/98%	2/5 lb.		
Ferro-manganese (net)—			
76/80% loose	£10 15 0 to £11 5 0		
76/80% packed	£11 15 0 to £12 5 0		
76/80% export	(nom.) £9 15 0		
Metallic manganese—			
94/96% carbon-free	1/2 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	12	6	to 2	15	0
Bundled steel and shrngs.	2	7	6	to 2	15	0
Mixed iron and steel	2	8	0	to 2	10	0
Heavy cast iron	2	7	6	to 2	8	6
Good machinery	2	7	6	to 2	10	0
Cleveland—						
Heavy steel			2	7	6	
Steel turnings			1	17	6	
Cast-iron borings			1	7	6	
Heavy forge			2	10	0	
W.I. piling scrap			2	5	0	
Cast-iron scrap	2	10	0	to 2	13	0
Midlands—						
Light cast-iron scrap			2	7	6	
Heavy wrought iron			3	0	0	
Steel turnings, f.o.r.			1	13	6	
Scotland—						
Heavy steel	2	12	6	to 2	13	6
Ordinary cast iron			2	15	0	
Engineers' turnings			2	2	6	
Cast-iron borings	2	1	3	to 2	2	6
Wrought-iron piling			2	14	3	
Heavy machinery			2	18	6	

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	28	0	0
Brass	20	0	0
Lead (less usual draft)	10	10	0
Tea lead	8	0	0
Zinc	9	10	0
New aluminium cuttings	70	0	0
Braziery copper	25	0	0
Gunmetal	26	0	0
Hollow pewter	155	0	0
Shaped black pewter	110	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/-
Foundry No. 3	57/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	68/-
Hematite M/Nos.	67/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/-
,, No. 3 fdry.	71/-
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/-
,, fdry. No. 3	71/-
,, fdry. No. 1	74/-
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/-
Hem. M/Nos. d/d	71/-
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	81/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/-
Staffs fdry. No. 3	74/-
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	85/-
Clyde, No. 3	85/-
Monkland, No. 3	85/-
Summerlee, No. 3	85/-
Eglinton, No. 3	85/-
Gartsherrie, No. 3	85/-
Shotts, No. 3	85/-

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	9	12	6	to 9	15	0
Nut and bolt iron	7	5	0	to 8	0	0
Hoops	10	10	0	to 12	0	0
Marked bars (Staffs) f.o.t.			12	0	0	
Gas strip	10	10	0	to 12	0	0
Bolts and nuts, ¾ in. × 4 in.	13	15	0			
Steel—						
Plates, ship, etc.	8	15	0	to 8	17	6
Boiler plts.	8	5	0	to 9	10	0
Chequer plts.			10	7	6	
Angles			8	7	6	
Tees			9	7	6	
Joists			8	15	0	
Rounds and squares, 3 in. to 5½ in.			9	7	6	
Rounds under 3 in. to ⅜ in. (Untested)			8	12	0	
Flats—8 in. wide and over			8	12	6	
,, under 8 in. and over 5 in.			8	17	6	
Rails, heavy	8	5	0	to 8	10	0
Fishplates	12	5	0	to 12	10	0
Hoops (Staffs)	10	10	0	& up.		
Black sheets, 24g. (4-t. lots)			10	5	0	
Galv. cor. shts. (,,)			12	15	0	
Galv. flat shts. (,,)			13	5	0	
Galv. fencing wire, 8g. plain			14	10	0	
Billets, soft			5	10	0	
Billets, hard	6	17	6	to 7	2	6
Sheet bars	5	0	0	to 5	5	0
Tin bars			5	0	0	

PHOSPHOR BRONZE

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	11½d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	19.26
No. 2 foundry, Valley	17.50
No. 2 foundry, Birm.	13.50
Basic, Valley	17.00
Bessemer	19.76
Malleable, Valley	17.50
Grey forge, Valley	17.50
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	26.00
Sheet bars	26.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	1.89
Steel bars	1.75
Tank plates	1.70
Beams, etc.	1.70
Skelp, grooved steel	1.60
Steel hoops	1.85
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.85
Wire nails	2.35
Plain wire	2.20
Barbed wire, galv.	2.85
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	18/6 to 19/-
Durham foundry	21/- to 25/-
,, furnace	17/6
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	16/3 to 16/6
,,	28×20 ,,	32/6 to 33/-
,,	20×10 ,,	23/6 to 23/9
,,	18¾×14 ,,	17/- to 17/3
C.W.	20×14 ,,	15/-
,,	28×20 ,,	31/- to 31/3
,,	20×10 ,,	21/6 to 21/9
,,	18¾×14 ,,	15/- to 15/3

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.	£	s.	d.
Pig-iron	£6	0	0	to £7	0	0
Bars-hammered, basis	£16	0	0	to £16	10	0
Bars and nail-rods, rolled, basis	£15	15	0	to £16	0	0
Blooms	£10	0	0	to £12	0	0
Keg steel	£30	0	0	to £31	0	0
Faggot steel	£18	0	0	to £23	0	0
Bars and rods dead soft, st'l	£10	0	0	to £12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

	£	s.	d.	
Mar. 15 ..	32	5	0	dec. 10/–
„ 16 ..	32	10	0	inc. 5/–
„ 19 ..	31	13	9	dec. 16/3
„ 20 ..	32	2	6	inc. 8/9
„ 21 ..	32	3	9	„ 1/3

Electrolytic Copper

	£	s.	d.	
Mar. 15 ..	35	10	0	dec. 10/–
„ 16 ..	35	10	0	No change
„ 19 ..	34	15	0	dec. 15/–
„ 20 ..	35	0	0	inc. 5/–
„ 21 ..	35	5	0	„ 5/–

Standard Tin (cash)

	£	s.	d.	
Mar. 15 ..	234	7	6	dec. 32/6
„ 16 ..	234	5	0	„ 2/6
„ 19 ..	232	15	0	„ 30/–
„ 20 ..	234	7	6	inc 32/6
„ 21 ..	234	15	0	„ 7/6

Tin (English ingots)

	£	s.	d.	
Mar. 15 ..	235	0	0	dec. 30/–
„ 16 ..	234	15	0	„ 5/–
„ 19 ..	233	5	0	„ 30/–
„ 20 ..	235	0	0	inc. 35/–
„ 21 ..	235	10	0	„ 10/–

Spelter (ordinary)

	£	s.	d.	
Mar. 15 ..	14	15	0	No change
„ 16 ..	14	12	6	dec. 2/6
„ 19 ..	14	11	3	„ 1/3
„ 20 ..	14	12	6	inc. 1/3
„ 21 ..	14	13	9	„ 1/3

Spelter (Electro, 99.9 per cent.)

	£	s.	d.	
Mar. 15 ..	17	2	6	No change
„ 16 ..	17	0	0	dec. 2/6
„ 19 ..	17	0	0	No change
„ 20 ..	17	0	0	„ „
„ 21 ..	17	0	0	„ „

Zinc Sheets (English)

	£	s.	d.	
Mar. 15 ..	24	10	0	No change
„ 16 ..	24	10	0	„ „
„ 19 ..	24	10	0	„ „
„ 20 ..	24	10	0	„ „
„ 21 ..	24	10	0	„ „

Lead (English)

	£	s.	d.	
Mar. 15 ..	13	0	0	No change
„ 16 ..	13	0	0	„ „
„ 19 ..	12	15	0	dec. 5/–
„ 20 ..	12	15	0	No change
„ 21 ..	12	15	0	„ „

Imports and Exports of Pig-Iron, Iron and Steel Castings, etc., in February and the two months, 1934, compared with a year ago.

	February.		Two months.		February.		Two months.	
	1933.	1934.	1933.	1934.	1933.	1934.	1933.	1934.
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Imports.								
Pig-iron, forge	—	—	—	—	—	—	—	—
„ foundry	4,245	3,192	7,658	6,603	12,924	9,059	24,549	18,784
„ acid	10	—	11	—	61	—	67	—
„ basic	—	4,000	5,031	10,601	—	10,650	13,840	28,251
Total (including other kinds)	4,255	8,391	12,700	20,552	12,985	26,693	38,456	66,794
Castings and forgings	120	78	201	240	3,328	2,861	5,245	7,432
Cast pipes and fittings	36	155	207	261	1,073	9,006	4,506	13,433
Stoves, grates, etc.	35	54	79	118	2,629	5,495	8,302	10,917
Baths	323	596	610	1,303	7,372	14,038	13,604	31,145
Hollow-ware, all kinds	242	168	316	439	7,879	8,835	12,298	22,575
Exports.								
Pig-iron, forge	272	93	414	124	1,051	396	1,681	503
„ foundry	2,413	4,048	5,925	8,903	9,114	14,598	20,954	31,960
„ acid	2,603	2,403	5,360	5,767	7,898	7,690	16,592	18,026
„ basic	385	20	575	565	1,647	73	2,372	1,820
Total	5,673	6,564	12,274	15,359	19,710	22,757	41,599	52,309
Castings and forgings	232	293	375	603	12,749	11,298	18,107	23,668
Cast pipes and fittings, up to 6 in. diameter	4,145	4,409	7,308	8,782	45,407	46,943	83,773	103,617
„ „ „ over 6 in. „	2,876	2,053	5,282	5,236	19,973	17,139	36,883	43,543
Stoves, grates, etc.	522	630	982	1,377	22,257	31,811	44,412	70,410
Sanitary cisterns	203	186	420	484	5,486	5,303	12,067	13,669
Bedsteads, inc. tubes therefor	277	391	600	1,017	11,237	14,658	23,977	33,789
Cast hollow-ware	303	222	643	539	12,605	8,447	25,887	21,490

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.
13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK
LIMPET

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,
CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.
ZETLAND ROAD, MIDDLESBROUGH.

XUM

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-
(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

PRACTICAL Foundry Manager, age 48, is open for re-engagement; 14 years' successful operation of large, well-known ironfoundries; thoroughly experienced in all classes of engineering and pipe work and capable of taking full control. Excellent testimonials.—Box 692, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED, Assistant Foundry Manager for large iron foundry in Yorkshire, producing medium-weight high-class castings subject to hydraulic pressure. Must be sound metallurgist. A knowledge of vertical pipe-moulding would be an advantage.—State in confidence age, experience, salary, to Box 688, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED, First-class Working Foreman for small Non-ferrous Foundry in South Wales. Good opportunity for man with thorough experience of mixtures of brass and bronze.—Apply, stating full particulars of experience and wages required, Box 686, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WORKING Foreman, also Cupola Man, required for iron foundry in North London: must both be first-class men accustomed to high-class work. State age, experience and wages required.—Box 690, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRY Manager or Head Foreman desires position. Long experience in control of well-known foundries producing Diesel-engine castings up to 20 tons. Thorough knowledge of all types moulding practice and moulding machines, including sand-slingers. Accustomed to modern sand-preparing and core-making plant. Excellent record. (239)

FOREMAN Patternmaker desires re-engagement. Has had complete control of small and large patternshops. Machine-tool, textile, general engineering. Patterns for plate-moulding and rapid production. Modern methods; used to controlling labour. (240)

PROPERTY

MAGNIFICENT
11 ACRES WORKS SITE.
SHEFFIELD.
145,000 Sq. Ft. of Shops.
SIDING CONNECTIONS
with L.M. & S. and L. & N.E. Rlys.
WELL-BUILT & COMMODIOUS OFFICES
Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—
THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1934 edition now ready. Price 42s. cloth bound, 52s. morocco. Order *YOUR* copy *NOW*.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

SANDBLAST PLANTS

Room, Rotary Barrel and Cabinet Types complete; 12 in stock.

SAND PLANT

Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.
Rotoil "Senior" Oil Core Sand Mixer.
Pneulec Sand Drying Plant, output 1 ton per hour.
Brearley Type Disintegrators.

MOULDING MACHINES

Hand and Pneumatic Types.
Also
Six Rowlands Double-ended Grinders for 24-in. dia. x 2-in. wheels.
Electrical and Belt-driven Blowers and Exhaust Fans, Ladles, etc., etc.

AIR COMPRESSORS

All sizes for high and low pressures.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD LTD.

VERT. DRILL, A.G., 3½" spin., 12 speeds, 36" swing.
New PNEU. SAND MOULDER, admit boxes 16" x 16" x 6".
BLOWING ENGINE, twin-beam type, 42" cyls., 8' 0" str.
2 "Blake" Hand-fired VERT. BOILERS, 15' 6" x 6' 6", 100 lbs. w.p.
Green's FUEL ECONOMISER of 32 pipes, 160 lbs. w.p.
Write for "Albion" Catalogue.
'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued*

'PHONE 2031 BERMONDSEY.
TILTING FURNACE, Morgan's Patent, Type "A," 600 lbs. capacity, coke-fired, worm-tilting.
STEAM HAMMER, 2-cwt. Cochrane, 7-in. cyl., anvil block.
POLISHING and RUMBLING BARREL, Canning, 1-cwt. capacity.
LEVELLING and BENDING SLABS, C.I., 8 ft. 6 in. x 4 ft. 6 in. x 5 in. thick; 8 ft. x 3 ft. x 4 in. and 5 ft. x 5 ft. x 5 in.

J. T. WILLIAMS & SONS, Engineers.
South Bermondsey Railway Station, London, S.E.16.

MISCELLANEOUS

PATTERNS.—Inferior Patterns make trouble in the foundry. Why not buy the best—they cost very little more.—Send to FURMSTON & LAWLOR, Letchworth, Herts.

WORK required for Hardinge Mills and Air Separators up to 250 mesh. Will collect raw material, warehouse, deliver finished product in bags. Very cut rates to keep plant occupied.—HIBBERTS, LIMITED, Octagon Works, Battersea, S.W.11. 'Phone: Batt. 6666.

'Phone: 287 SLOUGH

SANDBLAST PLANTS

12' × 9' Tilghman sandblast room, built of cast iron plates, complete with 400 cu. ft. Tilghman air compressor and all accessories **£290 Nett.**

6' × 6' × 8' Tilghman Sandblast room, similar to above, but with B.H.2 Tilghman horizontal compressor: price complete **£130**. Several small Tilghman plants.

6' "Jackman" rotary sandblast table. CHEAP seen working.

SAND PLANT

Herbert "Whizzer" type disintegrator, No. 1	£30
Rotary Sand Dryer by Titan	£55
Gyratory sand riddle with motor	£7
Large "Baillott" sand preparing plant CHEAP.	

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

RYLAND'S DIRECTORY
[2,200 pages 8½" × 5¼"].

The standard work of reference covering the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades.

1934 EDITION NOW READY.
Price 42/- cloth bound, 52/- Morocco.

INDUSTRIAL NEWSPAPERS, Ltd.
49, Wellington St., Strand, London, W.C.2.
Telephone: Temple Bar 3951 (5 lines).

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 3852 (2 Lines). MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."